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(71)Applicant : NISSAN MOTOR CO LTD

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(72)Inventor : AOKI ATSUSHI

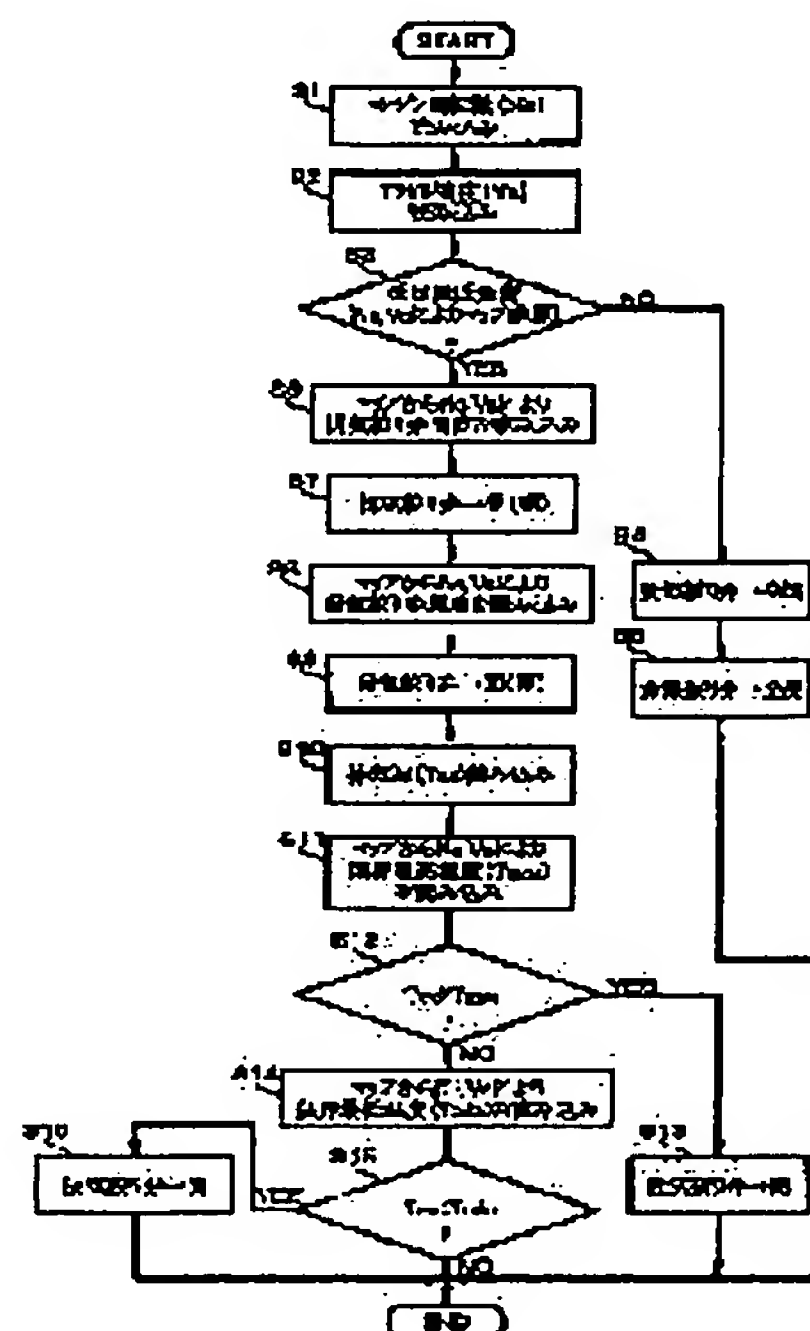
UEHARA TETSUYA

(54) COMPRESSION IGNITION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce vibration and noises under conditions of low number of rotations and low load while maintaining an in-cylinder temperature that enables favorable combustion in a compression ignition engine.

SOLUTION: Under conditions of low number of rotations and low load in a compression ignition engine, the opening angle of the intake throttle valve is reduced corresponding to the number of rotations and the load to lower the in-cylinder pressure (STEP 8, 9), thereby reducing vibration and noises. At the same time, the opening angle of the exhaust throttle valve is reduced in accordance with the number of rotations and the load (STEP 6, 7) to increase the amount of remaining gas. This causes the in-cylinder temperature to rise at the start of compression, thus maintaining an in-cylinder temperature favorable for combustion.



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CLAIMS

[Claim(s)]

[Claim 1] The compression ignition engine characterized by having a rise means whenever [cylinder internal temperature / which raises whenever / cylinder internal pressure fall means / to reduce the cylinder internal pressure at the time of compression initiation /, and cylinder internal temperature / at the time of compression initiation], and operating a rise means to coincidence by the predetermined operating range whenever [said cylinder internal pressure fall means and cylinder internal temperature].

[Claim 2] The compression ignition engine according to claim 1 characterized by said predetermined operating range being a low rotation low loading field.

[Claim 3] The compression ignition engine according to claim 1 or 2 with which a rise means is characterized by determining the control input which raises whenever [control input / to which cylinder internal pressure is reduced /, and cylinder internal temperature] according to an engine load and engine rotational speed, respectively whenever [said cylinder internal pressure fall means and cylinder internal temperature].

[Claim 4] The compression ignition engine of any one publication of claim 1-3 with which a rise means is characterized by raising whenever [cylinder internal temperature / at the time of compression initiation] whenever [said cylinder internal temperature] because an exhaust air line increases the amount of residual gas in the cylinder at the time of termination.

[Claim 5] The compression ignition engine according to claim 4 with which a rise means is characterized by an exhaust air line increasing the amount of residual gas in the cylinder at the time of termination by extracting the throttle valve infixed in the exhaust pipe whenever [said cylinder internal temperature].

[Claim 6] The compression ignition engine according to claim 4 with which a rise means is characterized by an exhaust air line increasing the amount of residual gas in the cylinder at the time of termination by bringing the closed stage of an exhaust valve forward whenever [said cylinder internal temperature].

[Claim 7] The compression ignition engine according to claim 4 with which a rise means is characterized by an exhaust air line increasing the amount of residual gas in the cylinder at the time of termination by delaying the closed stage of an exhaust valve and delaying the open stage of an inlet valve whenever [said cylinder internal temperature].

[Claim 8] The compression ignition engine according to claim 4 with which a rise means is characterized by an exhaust air line increasing the amount of residual gas in the cylinder at the time of termination by extracting the flow passage area of a nozzle which leads exhaust air to the exhaust gas turbine with which the exhaust pipe was equipped whenever [said cylinder internal temperature].

[Claim 9] The compression ignition engine of any one publication of claim 1-8 with which said cylinder internal pressure fall means is characterized by reducing the cylinder internal pressure at the time of compression initiation by extracting the throttle valve infixed in the inlet pipe.

[Claim 10] The compression ignition engine of any one publication of claim 1-8 with which said cylinder internal pressure fall means is characterized by reducing the cylinder internal pressure at the time of compression initiation by changing the closed stage of an inlet valve.

[Claim 11] The compression ignition engine of any one publication of claim 3-10 characterized by

establishing the amendment control means which amends the control input of a rise means or said cylinder internal pressure fall means whenever [said cylinder internal temperature] so that an exhaust-gas temperature may be below a marginal maximum temperature and it may become more than the marginal minimum temperature.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] This invention relates to the technique for reducing the vibration and the noise in a compression ignition engine in detail about a compression ignition engine.

[0002]

[Description of the Prior Art] A compression ignition engine (diesel power plant) has the property that the vibration and the noise at the time of low rotation low loading, such as an idling, are loud, while thermal efficiency is high compared with a spark-ignition engine (gasoline engine).

[0003] combustion -- the air-fuel ratio of gaseous mixture -- abbreviation -- the spark-ignition engine which keeps it constant and operates -- adjustment of an output -- gaseous mixture -- it is performed by adjustment of an amount, i.e., inspired air volume. Therefore, in order to extract an inlet pipe at the time of low loading and to reduce inspired air volume, cylinder internal pressure falls.

[0004] On the other hand, in the compression ignition engine, since it was the configuration of adjusting an output with fuel oil consumption, without adjusting inspired air volume, the cylinder internal pressure at the time of low loading became larger than a spark-ignition engine, and it had become the cause by which this became [vibration and the noise] larger than a spark-ignition engine at the time of low rotation low loading, such as an idling.

[0005] As an approach of reducing the vibration and the noise at the time of the low rotation low loading in such a compression ignition engine, the throttle valve was prepared in the inlet pipe like the spark-ignition engine, and there was a method of reducing cylinder internal pressure by performing an inhalation-of-air diaphragm at the time of low loading (refer to JP,8-061097,A).

[0006]

[Problem(s) to be Solved by the Invention] By the way, although temperature and a pressure affect ignition of the fuel which is a chemical reaction, since the reaction rate of a chemical reaction changes exponentially to temperature, in ignition of a fuel, it becomes dominant influencing it of temperature.

[0007] If an inhalation-of-air diaphragm is performed to some extent above, even when it falls, and whenever [near a compression top dead center / cylinder internal temperature] will not light or does not carry out a flame failure completely, aggravation (discharge of HC and a smoke) of emission will be caused from on the other hand, whenever [cylinder internal temperature] falling to coincidence, if an inhalation-of-air diaphragm is performed and cylinder internal pressure is reduced as mentioned above at the time of low loading.

[0008] Therefore, in order to secure ignitionability ability, it will be necessary to restrict the amount of inhalation-of-air diaphragms, and there was a problem that it was difficult to make even a spark-ignition engine and this extent reduce vibration and the noise.

[0009] This invention is made in view of the above-mentioned trouble, and it aims at enabling it to secure ignitionability ability in a compression ignition engine, reducing cylinder internal pressure to extent to which the vibration and the noise at the time of low rotation low loading may fully be reduced.

[0010]

[Means for Solving the Problem] Therefore, by invention according to claim 1, it had the rise means whenever [cylinder internal temperature / which raises whenever / cylinder internal pressure fall

means / to reduce the cylinder internal pressure at the time of compression initiation /, and cylinder internal temperature / at the time of compression initiation], and the rise means was considered as the configuration which operates coincidence by the predetermined operating range whenever [said cylinder internal pressure fall means and cylinder internal temperature].

[0011] When reducing the cylinder internal pressure at the time of compression initiation (at the time of termination like an inhalation-of-air line) with a cylinder internal pressure fall means according to this configuration A rise means is operated whenever [cylinder internal temperature / which raises whenever / cylinder internal temperature / at the time of compression initiation (at the time of termination like an inhalation-of-air line)], whenever [accompanying the fall of cylinder internal pressure / cylinder internal temperature], a fall is compensated in actuation of a rise means whenever [cylinder internal temperature] by coincidence, and whenever [required for compression ignition cylinder internal temperature] is secured to it.

[0012] In invention according to claim 2, it considered as the configuration which makes said predetermined operating range a low rotation low loading field. According to this configuration, the rise of whenever [cylinder internal temperature] is aimed at in low rotation low loading fields, such as an idling, reducing cylinder internal pressure.

[0013] In invention according to claim 3, the rise means cost whenever [said cylinder internal pressure fall means and cylinder internal temperature] for the configuration which determines the control input which raises whenever [control input / to which cylinder internal pressure is reduced /, and cylinder internal temperature], respectively according to an engine load and engine rotational speed.

[0014] According to this configuration, based on the control input according to an engine load and engine rotational speed, the fall of cylinder internal pressure and the rise of whenever [cylinder internal temperature] are controlled [in the predetermined operating range controlled to raise whenever / cylinder internal temperature / at the time of compression initiation / (low rotation low loading field)] at the same time it reduces the cylinder internal pressure at the time of compression initiation.

[0015] By invention according to claim 4, the rise means considered the exhaust air line as the configuration which raises whenever [cylinder internal temperature / at the time of compression initiation] whenever [said cylinder internal temperature] by increasing the amount of residual gas in the cylinder at the time of termination.

[0016] whenever [cylinder / increase / according to this configuration / the amount of residual gas (the amount of internals EGR) which remains in a cylinder, without being discharged like an exhaust air line / line / exhaust air / internal temperature / at the time of termination] -- high -- carrying out -- with -- **** -- whenever [cylinder internal temperature / at the time of compression initiation] is raised.

[0017] In invention according to claim 5, the rise means cost whenever [said cylinder internal temperature] for the configuration in which an exhaust air line increases the amount of residual gas in the cylinder at the time of termination by extracting the throttle valve infixed in the exhaust pipe.

[0018] According to this configuration, by extracting the throttle valve infixed in the exhaust pipe, an exhaust back pressure increases, the amount of residual gas increases, and whenever [cylinder internal temperature / at the time of compression initiation] goes up. In invention according to claim 6, the rise means cost whenever [said cylinder internal temperature] for the configuration in which an exhaust air line increases the amount of residual gas in the cylinder at the time of termination by bringing the closed stage of an exhaust valve forward.

[0019] According to this configuration, the capacity discharged out of a cylinder by the closed stage of an exhaust valve being brought forward becomes less, the amount of residual gas increases relatively, and whenever [cylinder internal temperature / at the time of compression initiation] goes up. In invention according to claim 7, the rise means cost whenever [said cylinder internal temperature] for the configuration in which an exhaust air line increases the amount of residual gas in the cylinder at the time of termination by delaying the closed stage of an exhaust valve and delaying the open stage of an inlet valve.

[0020] If according to this configuration delay the closed stage of an exhaust valve, and the open period of the exhaust valve after TDC is lengthened, and the open stage of an inlet valve is delayed

and overlap is lost, the once discharged exhaust air can return in a cylinder, the amount of residual gas will increase by this, and whenever [cylinder internal temperature / at the time of compression initiation] will go up.

[0021] In invention according to claim 8, the rise means cost whenever [said cylinder internal temperature] for the configuration in which an exhaust air line increases the amount of residual gas in the cylinder at the time of termination by extracting the flow passage area of a nozzle which leads exhaust air to the exhaust gas turbine with which the exhaust pipe was equipped.

[0022] When the flow passage area of a nozzle which an exhaust pipe is equipped with the exhaust gas turbine of an exhaust air turbocharger, and leads exhaust air to this exhaust gas turbine is constituted by adjustable according to this configuration, an exhaust back pressure is made to increase by extracting the flow passage area of said nozzle, thereby, the amount of residual gas is made to increase and whenever [cylinder internal temperature / at the time of compression initiation] is raised.

[0023] By invention according to claim 9, said cylinder internal pressure fall means considered as the configuration in which the cylinder internal pressure at the time of compression initiation is reduced by extracting the throttle valve infixed in the inlet pipe. According to this configuration, by extracting the throttle valve infixed in the inlet pipe, it sets like an inhalation-of-air line, the inhalation of air within the pipe one of the throttle valve downstream serves as negative pressure, and the cylinder internal pressure at the time of compression initiation (at the time of inhalation-of-air termination) falls.

[0024] By invention according to claim 10, said cylinder internal pressure fall means considered as the configuration in which the cylinder internal pressure at the time of compression initiation is reduced by changing the closed stage of an inlet valve. If according to this configuration the closed stage of an inlet valve is brought forward and it closes in front of a bottom dead point If inspired air volume decreases, and the cylinder internal pressure at the time of compression initiation (at the time of termination like an inhalation-of-air line) falls and the closed stage of an inlet valve is made late after a bottom dead point, the air once attracted in the cylinder will be discharged with a rise of a piston, inspired air volume will decrease, and the cylinder internal pressure at the time of compression initiation (at the time of termination like an inhalation-of-air line) will fall.

[0025] In invention according to claim 11, it considered as the configuration which establishes the amendment control means which amends the control input of a rise means or said cylinder internal pressure fall means whenever [said cylinder internal temperature] so that an exhaust-gas temperature might be below a marginal maximum temperature and it might become more than the marginal minimum temperature.

[0026] According to this configuration, when an exhaust-gas temperature is higher than a marginal maximum temperature While the control input of a rise means or said cylinder internal pressure fall means is amended whenever [cylinder internal temperature] in order to reduce whenever [cylinder internal temperature / at the time of compression initiation], when an exhaust-gas temperature is lower than the marginal minimum temperature The control input of a rise means or said cylinder internal pressure fall means is amended whenever [cylinder internal temperature] in order to make whenever [cylinder internal temperature / at the time of compression initiation] increase for reservation of ignition stability.

[0027]

[Effect of the Invention] It is effective in the ability to reduce the vibration and the noise in a predetermined operating range, controlling discharge of HC and a smoke, since according to invention according to claim 1 whenever [cylinder internal temperature] is raised and ignition stability is maintained so that the temperature fall by the fall of cylinder internal pressure may be compensated.

[0028] It is effective in the ability to reduce vibration and the noise, controlling discharge of HC and a smoke especially in a compression ignition engine at the time of low rotation low loading, such as an idling from which vibration and the noise pose a problem, according to invention according to claim 2.

[0029] According to invention according to claim 3, it is effective in the ability to reduce vibration and the noise, without affecting operability based on the proper control input according to a service

condition.

[0030] According to invention according to claim 4, whenever [cylinder internal temperature / at the time of compression initiation] can be positively made high by increasing the amount of residual gas, the fall of whenever [by reducing cylinder internal pressure / cylinder internal temperature] is compensated, and it is effective in being maintainable to the temperature which can maintain ignition stability.

[0031] According to invention according to claim 5, the amount of residual gas is increased by using the exhaust air throttle valve of simple structure, suppressing increase of cost, and it is effective in the ability to raise whenever [cylinder internal temperature / at the time of compression initiation].

[0032] According to invention of claim 6 and seven publications, it is effective in the increment in the pumping loss which the amount of residual gas can be controlled with a sufficient response, and whenever [cylinder internal temperature / at the time of compression initiation] can be raised with a sufficient response, and can control by control of the closed stage of an exhaust valve stably to the temperature which can maintain ignition stability, and can be set like an exhaust air line being avoidable.

[0033] If it is a compression ignition engine having the exhaust air turbocharger of an adjustable nozzle type according to invention according to claim 8, when reducing cylinder internal pressure, without making components cost increase, it is effective in the ability to increase the amount of residual gas and raise whenever [cylinder internal temperature / at the time of compression initiation].

[0034] According to invention according to claim 9, the cylinder internal pressure at the time of compression initiation is reduced by using the inhalation-of-air throttle valve of simple structure, suppressing increase of cost, and it is effective in the ability to reduce the vibration and the noise in a predetermined operating range.

[0035] According to invention according to claim 10, cylinder internal pressure can be controlled with a sufficient response by changing the closed stage of an inlet valve, and it is effective in the increment in the pumping loss like an inhalation-of-air line being avoidable.

[0036] According to invention according to claim 11, it is effective in the temperature from which it can avoid certainly that an exhaust-gas temperature rises even to the temperature exceeding heat-resistant limits, such as an exhaust valve, and good combustion is obtained being certainly maintainable.

[0037]

[Embodiment of the Invention] The gestalt of operation of this invention is explained based on drawing below. Drawing 1 is the system configuration Fig. of the compression ignition engine (diesel power plant) which shows the 1st operation gestalt.

[0038] In the cylinder of the compression ignition engine 1 which shows this drawing 1, air is attracted through an inlet pipe 2 and an inlet valve (illustration abbreviation), and the combustion exhaust air from the compression ignition engine 1 is discharged through an exhaust valve (illustration abbreviation) and an exhaust pipe 3.

[0039] The inhalation-of-air throttle valve 4 by which a closing motion drive is carried out in the middle of said inlet pipe 2 with the actuators (motor etc.) which carried out the illustration abbreviation is infixed, and while being said exhaust pipe 3, the exhaust air throttle valve 5 by which a closing motion drive is carried out with the actuators (motor etc.) which carried out the illustration abbreviation is infixed.

[0040] ***** KONTORO <TXF FR=0002 HE=250 WI=080 LX=1100 LY=0300>-

RUYUNITTO 6 controls the opening of said inhalation-of-air throttle valve 4 and the exhaust air throttle valve 5 for a microcomputer based on the detecting signal from various sensors. As said various sensors, the accelerator opening sensor 9 grade which detects the opening (accelerator opening) V_a of the rotational frequency sensor 7 which detects an engine speed N_e (rpm), the exhaust air temperature sensor 8 which detects the exhaust-gas temperature T_{ex} in the exhaust pipe 3 of said exhaust air throttle valve 5 upstream, and the accelerator pedal operated by the operator of a car is prepared.

[0041] Here, according to the flow chart of drawing 2, opening control of the inhalation-of-air throttle valve 4 by said control unit 6 and the exhaust air throttle valve 5 is explained to a detail. In

the flow chart of drawing 2 , the engine speed Ne (rpm) detected by the engine-speed sensor 7 is read, and the accelerator opening Va detected by the accelerator opening sensor 9 is read by STEP2 at STEP1. In addition, said accelerator opening Va is a parameter representing an engine load in this operation gestalt.

[0042] At STEP3, as shown in drawing 3 , it distinguishes whether it corresponds to said low rotation low loading field by distinguishing whether the engine speed Ne (rpm) and the accelerator opening Va which were read into the low rotation low loading field including the idling set up on the operating-range map which classifies a operating range by the engine speed Ne and the accelerator opening Va beforehand by said STEP 1 and 2 are contained.

[0043] In not corresponding to a low rotation low loading field, it progresses to STEP4, and the inhalation-of-air throttle valve 4 is controlled to full open, and it controls the exhaust air throttle valve 5 by following STEP5 to full open. On the other hand, in corresponding to a low rotation low loading field, it progresses to STEP6 and searches the target opening (control input) of the exhaust air throttle valve 5 from the map shown in drawing 4 .

[0044] The target opening map of the exhaust air throttle valve 5 shown in said 4 is a map on which the target opening of the exhaust air throttle valve 5 was beforehand set up according to an engine speed Ne (rpm) and the accelerator opening Va, and it is the property that the smaller opening as target opening of the exhaust air throttle valve 5 is set up, so that the accelerator opening Va is so small that an engine speed Ne (rpm) is low in said low rotation low loading field (so that an engine load is low).

[0045] The opening of the exhaust air throttle valve 5 is controlled by STEP7 to the target opening set up by said STEP6. Moreover, the target opening (control input) of the inhalation-of-air throttle valve 4 is searched with STEP8 from the map shown in drawing 5 .

[0046] The target opening map of the inhalation-of-air throttle valve 4 shown in said drawing 5 They are the target opening map of the exhaust air throttle valve 5, and the map on which the target opening of the inhalation-of-air throttle valve 4 was similarly set up beforehand according to an engine speed Ne (rpm) and the accelerator opening Va. In said low rotation low loading field It is the property that the smaller opening as target opening of the inhalation-of-air throttle valve 4 is set up, so that the accelerator opening Va is so small that an engine speed Ne (rpm) is low (so that an engine load is low).

[0047] The opening of the inhalation-of-air throttle valve 4 is controlled by STEP9 to the target opening set up by said STEP8. In STEP10, the exhaust-gas temperature Tex detected with the exhaust air temperature sensor 8 is read.

[0048] With reference to the map which memorized the marginal maximum temperature Tmax of an exhaust-gas temperature Tex according to an engine speed Ne (rpm) and the accelerator opening Va, the marginal maximum temperature Tmax corresponding to the engine speed Ne (rpm) and the accelerator opening Va at that time is searched with STEP11.

[0049] However, with this operation gestalt, the value of abbreviation regularity is memorized as a map value ** [/ operating range] in consideration of the thermal resistance of exhaust air system components, such as an exhaust valve, etc. Therefore, it is good also as a configuration which gives said marginal maximum temperature Tmax as a fixed value.

[0050] In STEP12, it distinguishes whether the current exhaust-gas temperature Tex is over said marginal maximum temperature Tmax. When the current exhaust-gas temperature Tex is over said marginal maximum temperature Tmax, it progresses to STEP13 and control which extracts further the opening of the inhalation-of-air throttle valve 4 rather than the control opening in STEP9 is performed.

[0051] When it is distinguished by STEP12 that the current exhaust-gas temperature Tex is said below marginal maximum temperature Tmax, it progresses to step S14. With reference to the map which memorized the marginal minimum temperature Tmin of an exhaust-gas temperature Tex according to an engine speed Ne (rpm) and the accelerator opening Va, the marginal minimum temperature Tmin corresponding to the engine speed Ne (rpm) and the accelerator opening Va at that time is searched with STEP14. As said marginal minimum temperature Tmin shows the minimum temperature required for ignition of a fuel and shows it to drawing 6 , as high temperature as a low rotation low loading side is required.

[0052] In STEP15, it distinguishes whether the current exhaust-gas temperature T_{ex} is less than said marginal minimum temperature T_{min} . If the present exhaust-gas temperature T_{ex} is said more than marginal minimum temperature T_{min} , opening of the inhalation-of-air throttle valve 4 controlled by said STEP9 will be left intact by terminating the routine shown in the flow chart of drawing 2.

[0053] On the other hand, when the current exhaust-gas temperature T_{ex} is less than said marginal minimum temperature T_{min} , it progresses to STEP16 and control which opens the inhalation-of-air throttle valve 4 more to the control opening in STEP9 is performed.

[0054] In control of said STEP 13 and 16 [whether only constant value changes opening from the control opening in STEP9, and] [whether the control opening in STEP9 is amended by said amendment opening by determining amendment opening according to the deflection of the critical temperature and the exhaust-gas temperature T_{ex} at that time, and] Or the opening of the inhalation-of-air throttle valve 4 is controlled to the opening which controls the opening of the inhalation-of-air throttle valve 4 to the fixed opening which set beforehand and was carried out, or is beforehand set up according to the critical temperature at that time.

[0055] The vibration and the noise in the low rotation low loading field distinguished by said STEP3 can be reduced by controlling the opening of the inhalation-of-air throttle valve 4 and the exhaust air throttle valve 5 as mentioned above.

[0056] That is, if the inhalation-of-air throttle valve 4 is extracted in a low rotation low loading field, the cylinder internal pressure at the time of the compression initiation which the pressure in the inlet pipe 2 of the inhalation-of-air throttle valve 4 downstream becomes lower than atmospheric pressure, and becomes as same the cylinder internal pressure as the time of termination as an inhalation-of-air line will become lower than the case where an inhalation-of-air diaphragm is not performed, the cylinder internal pressure a result and near a compression top dead center will fall, and the vibration and the noise in a low rotation low loading field will be reduced. Therefore, a cylinder internal pressure fall means is constituted in this operation gestalt by the inhalation-of-air diaphragm control function by said inhalation-of-air throttle valve 4 and control unit 6.

[0057] However, while cylinder internal pressure falls, whenever [near a compression top dead center / cylinder internal temperature] falls, if it remains as it is, ignition stability is spoiled by the above-mentioned inhalation-of-air diaphragm, and generating of a flame failure and aggravation of emission may be caused by it. Then, an inhalation-of-air diaphragm and coincidence are made to perform the exhaust air diaphragm by the exhaust air throttle valve 5, and whenever [cylinder internal temperature / at the time of compression initiation] is raised, and it enables it to have maintained ignition stability according to this exhaust air diaphragm with this operation gestalt.

[0058] Resistance of exhaust air becomes large, if the exhaust-air throttle valve 5 is extracted, the capacity discharged out of a cylinder like an exhaust-air line will decrease, the amount of residual gas in a cylinder will increase relatively, the condition in the cylinder in the time of an exhaust valve closing becomes elevated-temperature high pressure compared with the case where an exhaust-air diaphragm is not performed, and when an inlet valve opens, the inside of a cylinder has elevated-temperature high pressure compared with the case where an exhaust-air diaphragm is not performed. Although the residual gas in a cylinder will flow backwards to an inlet pipe 2 and mixing with residual gas and inhalation of air will progress within an inlet pipe 2 since the pressure in a cylinder is higher than the pressure in an inlet pipe 2 if an inlet valve opens, since the propagation of a pressure is very quicker than diffusion of the matter, and propagation of temperature, The condition in the cylinder like the continuing inhalation-of-air line has temperature and a presentation equal to abbreviation residual gas, and the pressure of abbreviation is in the pressure in the abbreviation inlet pipe 2 by carrying out, and will be in a condition.

[0059] Whenever [cylinder internal temperature / at the time of termination] becomes high by this compared with the case where an exhaust air diaphragm is not performed, like an inhalation-of-air line. Whenever [cylinder internal temperature / at the time of compression initiation] Since an inhalation-of-air line is equal to whenever [cylinder internal temperature / at the time of termination], whenever [cylinder internal temperature / at the time of compression initiation] becomes high by performing an exhaust air diaphragm, and even if the inhalation-of-air diaphragm is performed, whenever [cylinder internal temperature / at the time of compression initiation] can be maintained to whenever [cylinder internal temperature / which can perform good combustion].

[0060] Therefore, in a low rotation low loading field, since ignition stability will be secured, and aggravation of a flame failure or emission can be avoided and the inhalation-of-air throttle valve 4 and the exhaust air throttle valve 5 are held at full open except a low rotation low loading field, reducing vibration and the noise by the fall of ****, performance is not reduced.

[0061] In addition, since whenever [cylinder internal temperature / at the time of compression initiation] is made high according to an exhaust air diaphragm, a rise means is constituted whenever [cylinder internal temperature] by the exhaust air diaphragm control function by said exhaust air throttle valve 5 and control unit 6.

[0062] By the way, although the inhalation-of-air throttle valve 4 and the exhaust air throttle valve 5 are controlled by the above-mentioned control as that by which whenever [cylinder internal temperature] is controlled by expected temperature, control of whenever [cylinder internal temperature] is overdue to change of operational status, it may be less than whenever [cylinder internal temperature / which can perform good combustion], or a temperature rise may be conversely carried out exceeding the heat-resistant temperature of exhaust air system components, such as an exhaust valve. So, in STEP 12-16, priority is given over reduction control of vibration and the noise from the distinction result of an exhaust-gas temperature T_{ex} , and the opening of the inhalation-of-air throttle valve 4 is controlled by this operation gestalt.

[0063] That is, in the condition of exceeding the marginal maximum temperature T_{max} , the early rise of an exhaust-gas temperature is aimed at by aiming at the early fall of an exhaust-gas temperature, opening the inhalation-of-air throttle valve 4 more in the condition of being less than the marginal minimum temperature T_{min} , and raising cylinder internal pressure by closing the inhalation-of-air throttle valve 4 more, and reducing cylinder internal pressure.

[0064] Thus, if the inhalation-of-air throttle valve 4 is controlled so that whenever [cylinder internal temperature / at the time of compression initiation] can be certainly maintained to the temperature from which good combustion is obtained and an exhaust-gas temperature T_{ex} will not exceed the marginal maximum temperature T_{max} , if priority is given over reduction of vibration and the noise and the inhalation-of-air throttle valve 4 is controlled so that an exhaust-gas temperature T_{ex} is not less than the marginal minimum temperature T_{min} , it is certainly avoidable to carry out a temperature rise exceeding the heat-resistant temperature of exhaust-air system components, such as an exhaust valve.

[0065] In addition, the control of the inhalation-of-air throttle valve 4 based on the comparison with the exhaust-gas temperature T_{ex} shown in STEP12-STEP16, the marginal minimum temperature T_{min} , and the marginal maximum temperature T_{max} is equivalent to an amendment control means.

[0066] Furthermore, although the amount of residual gas is increased with the above-mentioned operation gestalt in order to raise whenever [cylinder internal temperature], combustion temperature falls because the amount of residual gas increases, and the effectiveness that NO_x can be reduced is also produced.

[0067] Drawing 7 is the system configuration Fig. of the compression ignition engine which shows the 2nd operation gestalt, and only points equipped with the good fluctuation valve system 10 which can change the closed stage of an inlet valve (illustration abbreviation) differ to the compression ignition engine 1 which showed said drawing 1, without having the inhalation-of-air throttle valve 4.

[0068] Although the device in which the device which switches two or more cams, the device in which the phase of a cam shaft is changed, etc. are well-known as said good fluctuation valve system 10 is applicable the electromagnetism of a configuration of carrying out the closing motion drive of the inlet valve with the electromagnet for clausiliums and the electromagnet for valve opening especially -- from [that a drive valve gear can change the closing motion stage of an inlet valve into arbitration in the large range continuously] -- most -- desirable -- this operation gestalt -- said electromagnetism -- a drive valve gear shall be used as a good fluctuation valve system 10

[0069] The 2nd operation gestalt is replaced with the throttling control of the inhalation-of-air throttle valve 4 in said 1st operation gestalt, it is changing the closed stage of an inlet valve by said good fluctuation valve system 10, and it is the configuration of reducing the cylinder internal pressure at the time of compression initiation in a low rotation low loading field, and the detail of the starting control is explained according to the flow chart of drawing 8.

[0070] In addition, although the step (STEP 4, 8, 9, 13, and 16) which performs processing about the inhalation-of-air throttle valve 4 in the flow chart of drawing 2 is changed into control of the closed stage of an inlet valve with the flow chart of drawing 8, the contents of processing in other steps are the same as that of the flow chart of drawing 2.

[0071] in the flow chart of drawing 8, if it is not a low rotation low loading field (refer to drawing 3) in STEP3, when it will be distinguished based on the engine speed N_e (rpm) and the accelerator opening V_a which were read by STEP 1 and 2, it is the latest stage in a control range about the closed stage of an inlet valve in STEP4 -- it usually sets up at a stage and the exhaust air throttle valve 5 is controlled by STEP5 to full open.

[0072] On the other hand, in being a low rotation low loading field, it progresses to STEP8, after controlling the exhaust air throttle valve 5 by STEP 6 and 7 to the opening (refer to drawing 4) according to an engine speed N_e (rpm) and the accelerator opening V_a .

[0073] In STEP8, it asks for the closed stage of an inlet valve with reference to the map which memorized the closed stage of an inlet valve beforehand according to an engine speed N_e (rpm) and the accelerator opening V_a . And in STEP9, a setup which closes an inlet valve with the closed stage set up by STEP8 is performed.

[0074] In the low rotation low loading field distinguished by STEP3, the earlier stage as a closed stage of an inlet valve is set up, and as the map which memorized the closed stage of said inlet valve is shown in drawing 9, the closed stage of an inlet valve is brought forward across a bottom dead point (BDC), as shown in drawing 10, so that a load is so small that rotation is low.

[0075] As mentioned above, if the closed stage of an inlet valve is brought forward in front of a bottom dead point (BDC), since an inlet valve will close in the middle of downward (like an inhalation-of-air line) of a piston and the inside of a cylinder will be sealed, if a bottom dead point is reached and it changes to a compression stroke, carrying out adiabatic expansion and lowering temperature after that, since compression will begin from near the piston location where the inlet valve was closed, a substantial compression ratio becomes small and cylinder internal pressure falls. Therefore, in the 2nd operation gestalt, a cylinder internal pressure fall means consists of a good fluctuation valve system 10 and a control function of the closed stage of the inlet valve by the control unit 6.

[0076] Thus, with the 2nd operation gestalt, by bringing the closed stage of an inlet valve forward, the cylinder internal pressure at the time of compression initiation is reduced, the vibration and the noise in a low rotation low loading field are reduced, and the fall of whenever [by the fall of cylinder internal pressure / cylinder internal temperature] is compensated by performing an exhaust air diaphragm like the 1st operation gestalt, and is maintained whenever [cylinder internal temperature / which can perform good combustion].

[0077] Moreover, with the 2nd operation gestalt, since an inhalation-of-air diaphragm is not performed, the pressure like an inhalation-of-air line serves as abbreviation atmospheric pressure, and the pumping loss like an inhalation-of-air line decreases compared with the 1st operation gestalt. Also in the 2nd operation gestalt, although control based on the comparison with an exhaust-gas temperature T_{ex} , the marginal maximum temperature T_{max} , and the marginal minimum temperature T_{min} is performed, since the cylinder internal pressure at the time of compression initiation is reduced by bringing the closed stage of an inlet valve forward, control based on said critical temperature T_{max} and T_{min} is also performed about the closed stage of an inlet valve.

[0078] That is, when it distinguishes by STEP12 whether the exhaust-gas temperature T_{ex} is over the marginal maximum temperature T_{max} and the exhaust-gas temperature T_{ex} is over the marginal maximum temperature T_{max} , processing to which the closed stage of an inlet valve is brought more forward by STEP13, and cylinder internal pressure is reduced further is performed in order to reduce an exhaust-gas temperature T_{ex} .

[0079] Moreover, if an exhaust-gas temperature T_{ex} is below the marginal maximum temperature T_{max} , when it will distinguish by STEP15 whether the exhaust-gas temperature T_{ex} is less than the marginal minimum temperature T_{min} and an exhaust-gas temperature T_{ex} will be less than the marginal minimum temperature T_{min} , cylinder internal pressure is raised by making the closed stage of an inlet valve late by STEP16, and it enables it to secure whenever [cylinder internal temperature / which can perform good combustion].

[0080] Control of the closed stage of the inlet valve in said STEP 13 and 16 [whether only constant value amends a closed stage as well as control of the inhalation-of-air throttle valve 4 in the 1st operation gestalt, and] [whether a closed stage is amended with the correction value according to the deflection of the critical temperature T_{max} and T_{min} and the exhaust-gas temperature T_{ex} at that time, and] Or it is carried out by changing the closed stage of an inlet valve at the fixed stage which set beforehand and was carried out, or changing the closed stage of an inlet valve at the closed stage according to the critical temperature T_{max} and T_{min} at that time.

[0081] With the 2nd operation gestalt, the control of the closed stage of an inlet valve based on the comparison with the exhaust-gas temperature T_{ex} shown in STEP12-STEP16, the marginal minimum temperature T_{min} , and the marginal maximum temperature T_{max} is equivalent to an amendment control means.

[0082] In addition, although considered as the configuration in which a compression ratio is small carried out by bringing the closed stage of an inlet valve forward, and cylinder internal pressure is reduced with the operation gestalt of the above 2nd, it is possible to make a compression ratio small and to reduce cylinder internal pressure conversely, by making the closed stage of an inlet valve late after a bottom dead point (BDC). Since compression will start after the air once attracted in the cylinder is returned with the rise of the cylinder internal pressure by rise of a piston at an inlet-pipe 2 side and an inlet valve is closed if the closed stage of an inlet valve is made late after a bottom dead point (BDC), a substantial compression ratio becomes small and cylinder internal pressure will fall.

[0083] Drawing 11 is the system configuration Fig. of the compression ignition engine which shows the 3rd operation gestalt, and only points equipped with the good fluctuation valve system 11 which can change the closed stage of an exhaust valve (illustration abbreviation) differ to the compression ignition engine 1 which showed said drawing 1, without having the exhaust air throttle valve 5.

[0084] the electromagnetism of a configuration of carrying out the closing motion drive of the exhaust valve with the electromagnet for clausiliums and the electromagnet for valve opening like the good fluctuation valve system 10 which changes the closing motion stage of an inlet valve as said good fluctuation valve system 11 -- a drive valve gear shall be used

[0085] With the 3rd operation gestalt, it replaces with the throttling control of the exhaust air throttle valve 5 in the 1st operation gestalt, and by changing the closed stage of an exhaust valve by said good fluctuation valve system 11, it is the configuration of raising whenever [cylinder internal temperature / at the time of compression initiation] in a low rotation low loading field, and the detail of the starting control is explained according to the flow chart of drawing 12.

[0086] In addition, it differs in that the step (STEP 5, 6, and 7) which performs processing concerning [the flow chart of drawing 12] the exhaust air throttle valve 5 of the flow chart of drawing 2 is changed into control of the closed stage of an exhaust valve.

[0087] an inhalation-of-air throttle valve is controlled to full open, and it is in a control range about the closed stage of an exhaust valve in STEP5, and the latest in the flow chart of drawing 12, when it will be distinguished based on the engine speed N_e (rpm) and the accelerator opening V_a which were read by STEP 1 and 2, if it is not a low rotation low loading field in STEP3 at STEP4 -- it usually sets up at a stage.

[0088] On the other hand, in being a low rotation low loading field (refer to drawing 3), with reference to the map which memorized the closed stage of an exhaust valve beforehand according to an engine speed N_e (rpm) and the accelerator opening V_a , it asks for the closed stage of an exhaust valve by STEP6. The earlier stage as a closed stage of an exhaust valve is set up, and it is made to be set up by a closed stage being brought forward in front of TDC in the closed stage, as shown in drawing 14, so that a load is so small that rotation is low in a low rotation low loading field again, as the map which memorized the closed stage of said exhaust valve is shown in drawing 13.

[0089] And in STEP7, a setup which closes an exhaust valve with the closed stage set up by STEP6 is performed. As mentioned above, if the closed stage of an exhaust valve is brought forward, whenever [cylinder internal temperature / at the time of compression initiation] will go up like the time of the capacity discharged out of a cylinder like an exhaust air line decreasing, and the amount of residual gas performing increase and an exhaust air diaphragm relatively.

[0090] In addition, in the 3rd operation gestalt, the control function of the closed stage of the exhaust valve by said good fluctuation valve system 11 and control unit 6 will be [whenever / cylinder

internal temperature] equivalent to a rise means.

[0091] Therefore, with the 3rd operation gestalt, reducing the cylinder internal pressure at the time of compression initiation by extracting an inhalation-of-air throttle valve, and reducing the vibration and the noise in a low rotation low loading field by this, the fall of whenever [by the fall of cylinder internal pressure / cylinder internal temperature] is compensated with bringing the closed stage of an exhaust valve forward and increasing the amount of residual gas, and is maintained to whenever [cylinder internal temperature / which can perform good combustion].

[0092] In a configuration of performing an exhaust-air diaphragm and increasing the amount of residual gas like the 1st and 2nd operation gestalt, delay arises in adjustment of the amount of residual gas with the exhaust-air volume of the exhaust-air throttle valve upstream, but the amount of residual gas can adjust with a sufficient response, and if it is the configuration of adjusting the amount of residual gas with the closed stage of an exhaust valve, whenever [required for combustion cylinder internal temperature] can maintain as mentioned above, without producing transitional delay to change of a service condition.

[0093] Drawing 15 is the system configuration Fig. of the compression ignition engine which shows the 4th operation gestalt, and points equipped with the good fluctuation valve system 10 which can change the closed stage of an inlet valve (illustration abbreviation), and the good fluctuation valve system 11 which can change the closed stage of an exhaust valve (illustration abbreviation) differ to the compression ignition engine 1 which showed said drawing 1, without having the inhalation-of-air throttle valve 4 and the exhaust air throttle valve 5.

[0094] By namely, the thing for which it replaces with the throttling control of said inhalation-of-air throttle valve 4, and the closed stage of an inlet valve is changed by said good fluctuation valve system 10 with the 4th operation gestalt By reducing the cylinder internal pressure at the time of compression initiation in a low rotation low loading field (the 2nd being the same as that of an operation gestalt), and replacing with the throttling control of said exhaust air throttle valve 5, and changing the closed stage of an exhaust valve by said good fluctuation valve system 11 It is the configuration of raising whenever [cylinder internal temperature / at the time of compression initiation] in a low rotation low loading field (the 3rd is the same as that of an operation gestalt).

[0095] Although the detail of the control in this 4th operation gestalt is shown in the flow chart of drawing 16 The step (STEP 4, 8, 9, 13, and 16) in connection with control of the closed stage of an inlet valve It is the same as that of what was explained with the 2nd operation gestalt, and the step (STEP 5, 6, and 7) in connection with control of the closed stage of an exhaust valve is the same as that of what was explained with the 3rd operation gestalt, and detailed explanation here is omitted.

[0096] In the operation gestalt of the above 4th, in a low rotation low loading field, as shown in drawing 17, cylinder internal pressure is reduced by what the closed stage of an inlet valve is brought forward for (or it delays), and it maintains to whenever [cylinder internal temperature / which can perform good combustion], making the amount of residual gas increase to coincidence by bringing the closed stage of an exhaust valve forward, aiming at the rise of whenever [cylinder internal temperature] to it, and making it reduce the vibration and the noise in a low rotation low loading field.

[0097] With the above-mentioned configuration, it is stably maintainable to whenever [cylinder internal temperature / which can perform increase control of the amount of residual gas for being able to reduce cylinder internal pressure, without making the pumping loss like an inhalation-of-air line increase, and raising whenever / cylinder internal temperature / on time, and can perform good combustion].

[0098] It is the system configuration Fig. of the compression ignition engine which shows the 5th operation gestalt, and drawing 18 is a configuration equipped with the inhalation-of-air throttle valve 4 while it is equipped with the good fluctuation valve system 12 which can change the open stage of an inlet valve (illustration abbreviation), and the good fluctuation valve system 11 which can change the closed stage of an exhaust valve (illustration abbreviation).

[0099] in addition -- as the good fluctuation valve system 12 which can change the open stage of an inlet valve (illustration abbreviation) -- electromagnetism -- a drive valve gear shall be used And with the 5th operation gestalt, while reducing cylinder internal pressure according to the inhalation-of-air diaphragm by the inhalation-of-air throttle valve 4, it has the composition of raising whenever

[cylinder internal temperature] by delay control of the closed stage of an exhaust valve, and the open stage of an inlet valve.

[0100] The flow chart of drawing 19 shows the detail of the control in the operation gestalt of the above 5th, if it is not a low rotation low loading field in STEP3 and will be distinguished based on the engine speed Ne (rpm) and the accelerator opening Va which were read by STEP 1 and 2, it will be STEP4, will control the inhalation-of-air throttle valve 4 to full open, and will set up the open stage of an inlet valve, and the closed stage of an exhaust valve early (usually stage) in following STEP5.

[0101] On the other hand, in being a low rotation low loading field, it progresses to STEP6 and asks for the closed stage of an exhaust valve, and the open stage of an inlet valve with reference to the map which memorized the closed stage of an exhaust valve, and the open stage of an inlet valve beforehand according to an engine speed Ne (rpm) and the accelerator opening Va.

[0102] And in STEP7, a setup which opens an inlet valve with the open stage which closed the exhaust valve with the closed stage set up by STEP6, and was set up by STEP6 is performed. The map which memorized the closed stage of said exhaust valve, and the open stage of an inlet valve The closed stage of an exhaust valve and the open stage of an inlet valve are delayed, so that a load is so small that rotation is low in a low rotation low loading field again, as shown in drawing 20 . In detail The open stage of an inlet valve is delayed after the closed stage of an exhaust valve so that the closed stage of an exhaust valve may be delayed after a top dead center (TDC) and the open period of an inlet valve may not overlap the open period of an exhaust valve (refer to drawing 21).

[0103] Although the gas once discharged out of the cylinder will be returned in a cylinder, the amount of residual gas will increase and whenever [cylinder internal temperature / at the time of compression initiation] will be raised according to increase of this amount of residual gas if the closed stage of an exhaust valve is delayed after a top dead center (TDC) Since it scavenges and it becomes impossible to increase the amount of residual gas when there is an overlap period, the open stage of an inlet valve is delayed according to delaying the closed stage of an exhaust valve, and an overlap period is abolished.

[0104] With this 5th operation gestalt, the pumping loss like an exhaust air line can be made small compared with the case where the amount of residual gas is increased, according to an exhaust air diaphragm. In addition, in the 5th operation gestalt, the control function which delays the closed stage of the exhaust valve by the good fluctuation valve systems 11 and 12 and the control unit 6 and the open stage of an inlet valve is [whenever / cylinder internal temperature] equivalent to a rise means.

[0105] Drawing 22 is the system configuration Fig. of the compression ignition engine which shows the 6th operation gestalt, and is a configuration equipped with the good fluctuation valve system 13 which can change the open stage and closed stage of an inlet valve (illustration abbreviation), and the good fluctuation valve system 11 which can change the closed stage of an exhaust valve (illustration abbreviation), without having the inhalation-of-air throttle valve 4 and the exhaust air throttle valve 5.

[0106] in addition -- as the good fluctuation valve system 13 which can change the open stage and closed stage of an inlet valve -- electromagnetism -- a drive valve gear shall be used And with the 6th operation gestalt, like said 5th operation gestalt, while consisting of delaying the closed stage of an exhaust valve, and the open stage of an inlet valve so that the amount of residual gas may be increased, it is the configuration of reducing the cylinder internal pressure at the time of compression initiation like the 2nd operation gestalt by what the closed stage of an inlet valve is brought forward for (or it is made late) (refer to drawing 23).

[0107] The flow chart of drawing 24 shows the control in the operation gestalt of the above 6th to a detail, if it is not a low rotation low loading field in STEP3 and will be distinguished based on the engine speed Ne (rpm) and the accelerator opening Va which were read by STEP 1 and 2, it will be STEP4, will make the closed stage of an inlet valve the latest, and will set up the open stage of an inlet valve, and the closed stage of an exhaust valve early in following STEP5.

[0108] On the other hand, in being a low rotation low loading field, it progresses to STEP6 and sets up a stage later than the time of not being a low rotation low loading field as the closed stage of an exhaust valve, and an open stage of an inlet valve with reference to the map (drawing 20) which

memorized the closed stage of an exhaust valve, and the open stage of an inlet valve beforehand according to an engine speed N_e (rpm) and the accelerator opening V_a .

[0109] And in STEP7, a setup which opens an inlet valve with the open stage which closed the exhaust valve with the closed stage set up by STEP6, and was set up by STEP6 is performed. By processing which delays both the closed stage of an exhaust valve here, and the open stage of an inlet valve, the amount of residual gas increases and whenever [cylinder internal temperature] goes up.

[0110] At STEP8, a setup to which the time of low rotation low loading brings the closed stage of an inlet valve forward is performed (refer to drawing 9), the closed stage of an inlet valve is controlled at STEP9 based on said setup, and cylinder internal pressure is reduced by bringing the closed stage of an inlet valve forward.

[0111] Moreover, when the closed stage of an inlet valve is brought more forward, cylinder internal pressure is further reduced, when an exhaust-gas temperature T_{ex} exceeds the marginal maximum temperature T_{max} , and an exhaust-gas temperature T_{ex} is less than the marginal minimum temperature T_{min} , it is made to go up in STEP 12-16 even to even whenever [cylinder internal temperature / to which the closed stage of an inlet valve can be made late, cylinder internal pressure can be raised, and good combustion can be made to perform].

[0112] Although drawing 25 is the system configuration Fig. of the compression ignition engine which shows the 7th operation gestalt and it has the inhalation-of-air throttle valve 4, it did not have the exhaust air throttle valve 5, and it is equipped with the exhaust air turbocharger 15 of an adjustable nozzle type.

[0113] As shown in drawing 26 , the exhaust air turbocharger 15 of said adjustable nozzle type is the thing equipped with the nozzle vane (variable wing) 21 which can change opening to the surroundings of the rotary wing 20 of an exhaust gas turbine, and when said nozzle vane (variable wing) 22 is closed, it is the configuration that the area of the passage to which exhaust air is led is extracted to a rotary wing 20.

[0114] With the operation gestalt of the above 7th, like the 1st operation gestalt, although an inhalation-of-air diaphragm performs the fall of cylinder internal pressure, it has the composition that adjustment of the exhaust back pressure by control of said ZURUBEN (variable wing) 21 performs the rise of whenever [by increase of the amount of residual gas / cylinder internal temperature].

[0115] As shown in the flow chart of drawing 27 , when it is not a low rotation low loading field, the inhalation-of-air throttle valve 4 is controlled by STEP4 to full open, and, specifically, said nozzle vane 21 (VN) is controlled by STEP5 to full open.

[0116] On the other hand, in a low rotation low loading field, with reference to the map which memorized opening for the nozzle vane 21 (VN) beforehand by STEP6 according to an engine speed N_e (rpm) and the accelerator opening V_a , it asks for the target opening of the nozzle vane 21 (VN), and the opening of the nozzle vane 21 (VN) is controlled by STEP7 to said target opening.

[0117] The opening map of said nozzle vane 21 (VN) has the composition that a low rotation low loading side extracts the opening of the nozzle vane 21 (VN) as shown in drawing 28 , exhaust gas pressure goes up by extracting the opening of the nozzle vane 21 (VN), it is that the amount of residual gas increases, and whenever [cylinder internal temperature / at the time of compression initiation] goes up. Therefore, a rise means is constituted from the exhaust air turbocharger 12 of said adjustable nozzle type, and the opening control function of the nozzle vane 21 by the control unit 6 (VN) by the 7th operation gestalt whenever [cylinder internal temperature].

[0118] On the other hand, the inhalation-of-air throttle valve 4 is controlled by the low rotation low loading side to extract opening, and a low rotation low loading side reduces cylinder internal pressure. With the operation gestalt of the above 7th, there is an advantage that the rise of whenever [cylinder internal temperature] can be aimed at, without adding components, if it is an engine having the exhaust air turbocharger 12 of an adjustable nozzle type.

[0119] In addition, although the supercharge by the exhaust air turbocharger 12 becomes the hindrance of an inhalation-of-air diaphragm, in low rotation low loading fields, such as an idling, the effectiveness of the exhaust air turbocharger 15 is bad, and since supercharge is not performed in fact, an inhalation-of-air diaphragm is not affected.

[0120] Drawing 29 is the system configuration Fig. of the compression ignition engine which shows

the 8th operation gestalt, and is equipped with the good fluctuation valve system 10 which can change the closed stage of an inlet valve, and the exhaust air turbocharger 15 of an adjustable nozzle type.

[0121] By controlling the opening of the nozzle vane 21 of the adjustable nozzle type exhaust air turbocharger 15 (VN) by this 8th operation gestalt like the 7th operation gestalt to be shown in the flow chart of drawing 30 While aiming at the rise of whenever [in a low rotation low loading field / cylinder internal temperature], the fall of the cylinder internal pressure in a low rotation low loading field is aimed at like the 2nd operation gestalt by control (refer to drawing 9) which brings the closed stage of an inlet valve forward (or it delays).

[0122] With this 8th operation gestalt, to the 7th operation gestalt, since an inhalation-of-air diaphragm is not performed, the pumping loss which can be set like an inhalation-of-air line can be made small. In addition, in the above operation gestalten [1-8th], although the amendment control means consists of cylinder internal pressure fall means sides, it may constitute an amendment control means from a rise means side whenever [cylinder internal temperature].

[0123] When an exhaust air throttle valve constitutes an amendment control means, by STEP13 of drawing 2 and drawing 8 An exhaust air throttle valve -> namely, the open, When it considers as exhaust air throttle valve -> close by STEP16 and an exhaust air valve-closing time term constitutes an amendment control means, It carries out. STEP13 of drawing 12 and drawing 15 -- exhaust-valve-closes -> ** and STEP16 -- exhaust-valve-closes -> -- already -- ** -- the case where an inhalation-of-air valve-opening stage constitutes an amendment control means an exhaust air valve-closing time term -- STEP13 of drawing 19 and drawing 24 -- exhaust-valve-closes -> -- already -- inhalation-of-air valve-opening -> -- already What is necessary is to consider as the VN-> open by STEP13 of drawing 27 and drawing 30 , and just to consider as the VN-> close by STEP16, when it considers as exhaust-valve-closes -> ** and inhalation-of-air valve-opening -> ** by STEP16 and VN opening constitutes an amendment control means.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The system configuration Fig. showing the compression ignition engine in the 1st operation gestalt.

[Drawing 2] The flow chart which shows the contents of control in the 1st operation gestalt.

[Drawing 3] Drawing showing the low rotation low loading field map in the 1st operation gestalt.

[Drawing 4] Drawing showing the opening map of the exhaust air throttle valve in the 1st operation gestalt.

[Drawing 5] Drawing showing the opening map of the inhalation-of-air throttle valve in the 1st operation gestalt.

[Drawing 6] Drawing showing the marginal minimum-temperature map in the 1st operation gestalt.

[Drawing 7] The system configuration Fig. showing the compression ignition engine in the 2nd operation gestalt.

[Drawing 8] The flow chart which shows the contents of control in the 2nd operation gestalt.

[Drawing 9] Drawing showing the closed stage map of the inlet valve in the 2nd operation gestalt.

[Drawing 10] Drawing showing the control characteristic of the closed stage of the inlet valve in the 2nd operation gestalt.

[Drawing 11] The system configuration Fig. showing the compression ignition engine in the 3rd operation gestalt.

[Drawing 12] The flow chart which shows the contents of control in the 3rd operation gestalt.

[Drawing 13] Drawing showing the closed stage map of the exhaust valve in the 3rd operation gestalt.

[Drawing 14] Drawing showing the control characteristic of the closed stage of the exhaust valve in the 3rd operation gestalt.

[Drawing 15] The system configuration Fig. showing the compression ignition engine in the 4th operation gestalt.

[Drawing 16] The flow chart which shows the contents of control in the 4th operation gestalt.

[Drawing 17] Drawing showing the control characteristic of the closed stage of the exhaust valve in the 4th operation gestalt, and the closed stage of an inlet valve.

[Drawing 18] The system configuration Fig. showing the compression ignition engine in the 5th operation gestalt.

[Drawing 19] The flow chart which shows the contents of control in the 5th operation gestalt.

[Drawing 20] Drawing showing the closed stage of the exhaust valve in the 5th operation gestalt, and the open stage map of an inlet valve.

[Drawing 21] Drawing showing the control characteristic of the closed stage of the exhaust valve in the 5th operation gestalt, and the open stage of an inlet valve.

[Drawing 22] The system configuration Fig. showing the compression ignition engine in the 6th operation gestalt.

[Drawing 23] Drawing showing the control characteristic of the closed stage of the exhaust valve in the 6th operation gestalt, and the closing motion stage of an inlet valve.

[Drawing 24] The flow chart which shows the contents of control in the 6th operation gestalt.

[Drawing 25] The system configuration Fig. showing the compression ignition engine in the 7th operation gestalt.

[Drawing 26] Drawing showing the 7th exhaust gas turbine and nozzle vane in an operation gestalt in a detail.

[Drawing 27] The flow chart which shows the contents of control in the 7th operation gestalt.

[Drawing 28] Drawing showing the opening map of the nozzle vane in the 7th operation gestalt.

[Drawing 29] The system configuration Fig. showing the compression ignition engine in the 8th operation gestalt.

[Drawing 30] The flow chart which shows the contents of control in the 8th operation gestalt.

[Description of Notations]

1 -- Compression ignition engine

2 -- Inlet pipe

3 -- Exhaust pipe

4 -- Inhalation-of-air throttle valve

5 -- Exhaust air throttle valve

6 -- Control unit

7 -- Rotational frequency sensor

8 -- Exhaust air temperature sensor

9 -- Accelerator opening sensor

10-13 -- Good fluctuation valve system

15 -- Exhaust air turbocharger

21 -- Nozzle vane

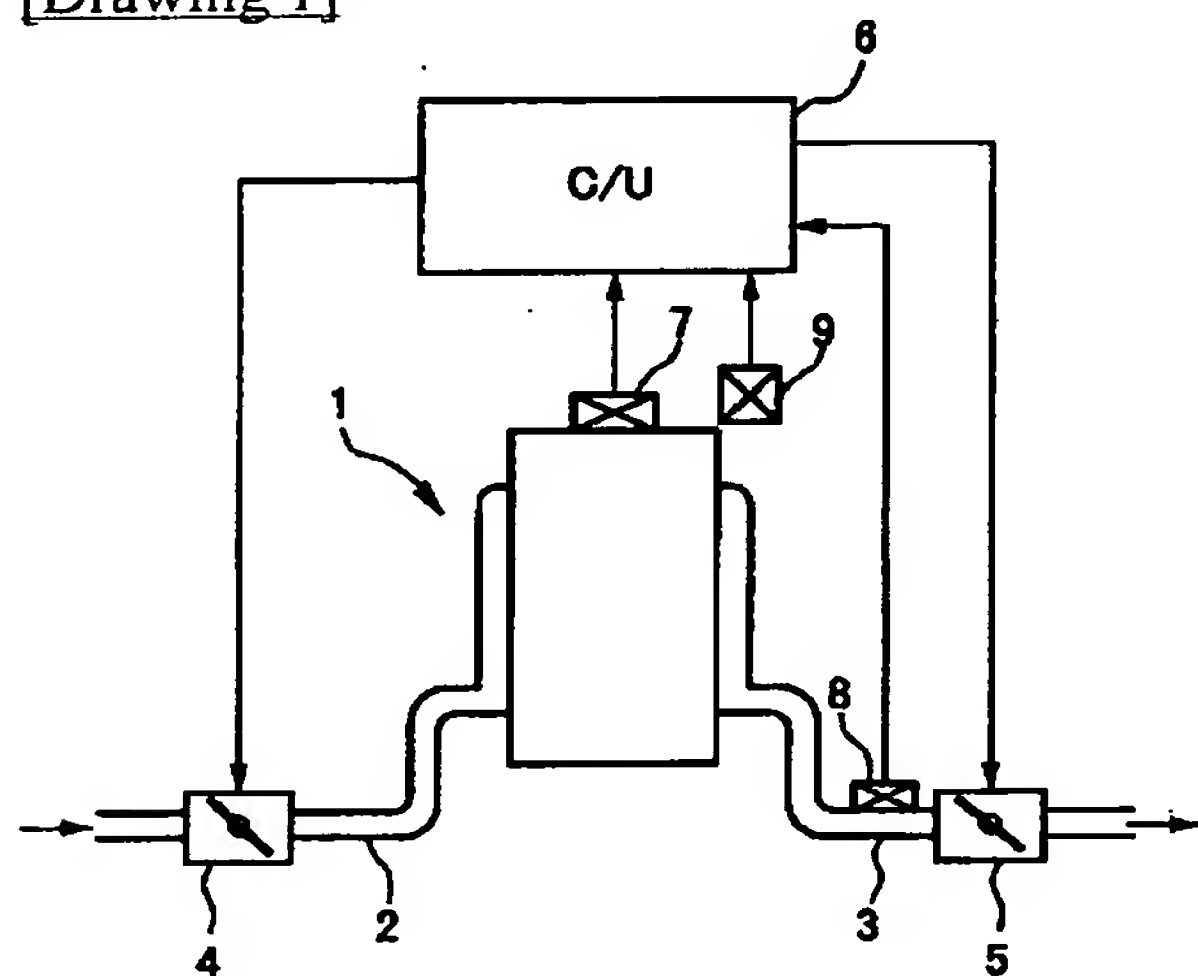
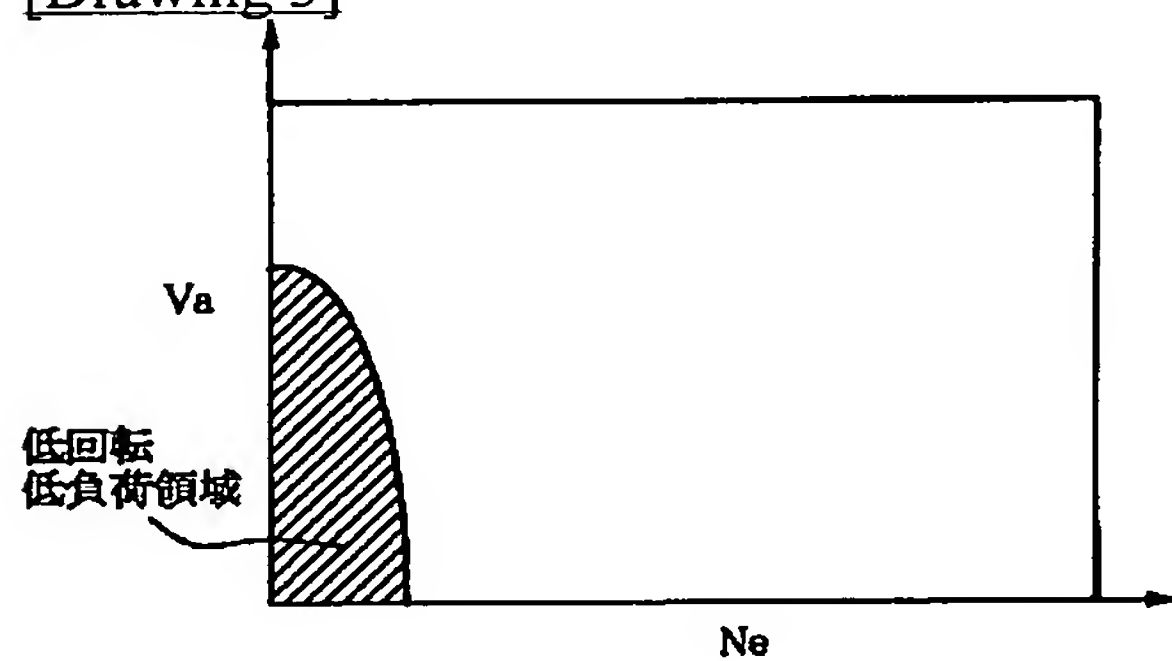
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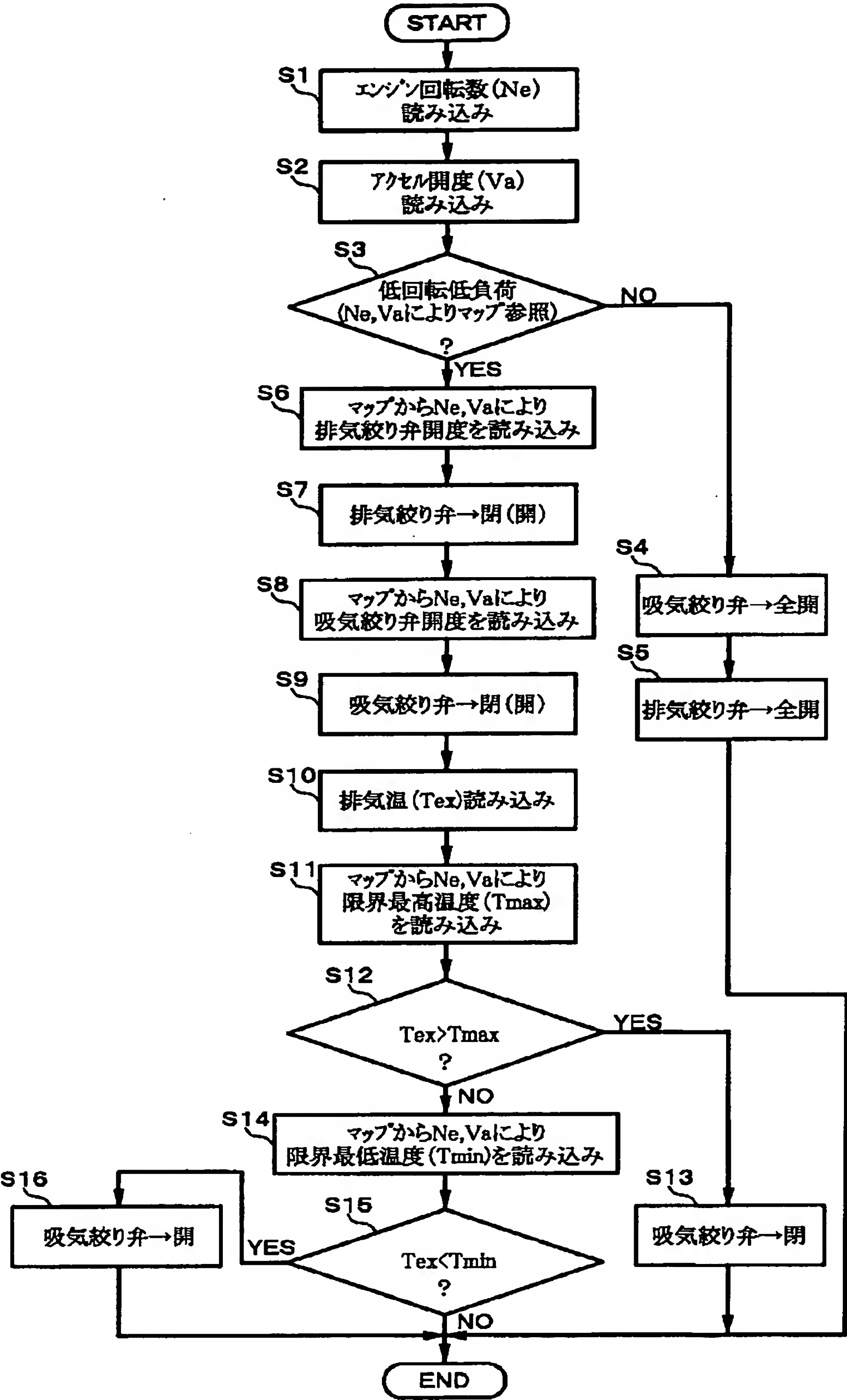
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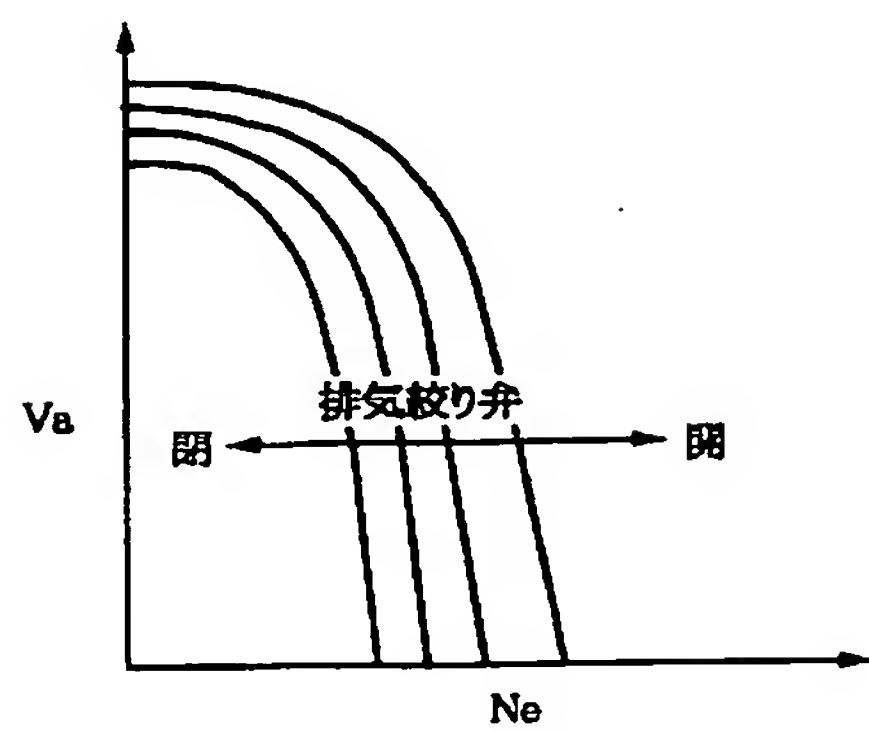
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DRAWINGS

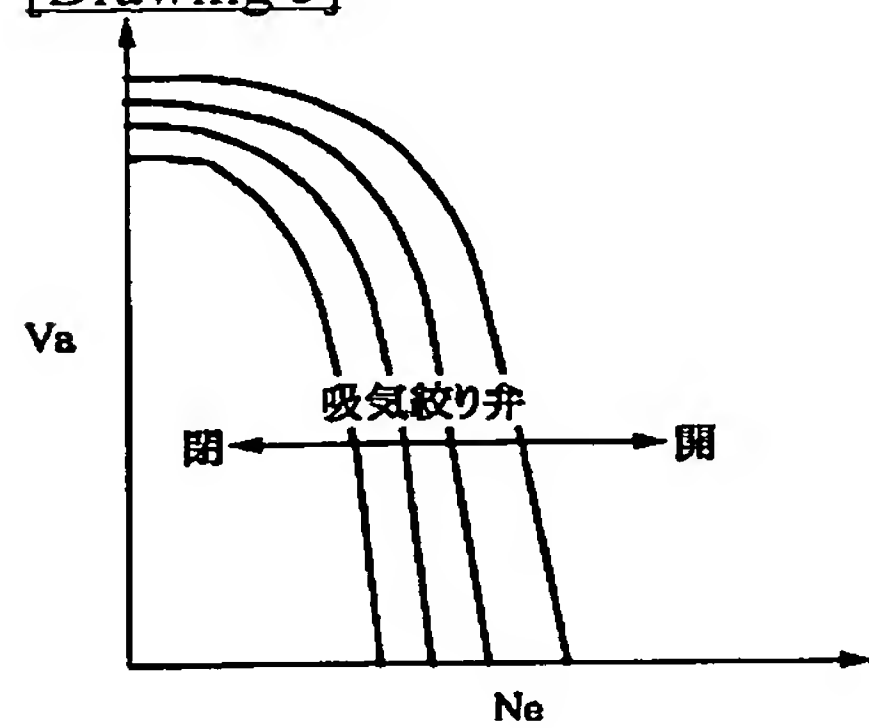
[Drawing 1][Drawing 3][Drawing 2]



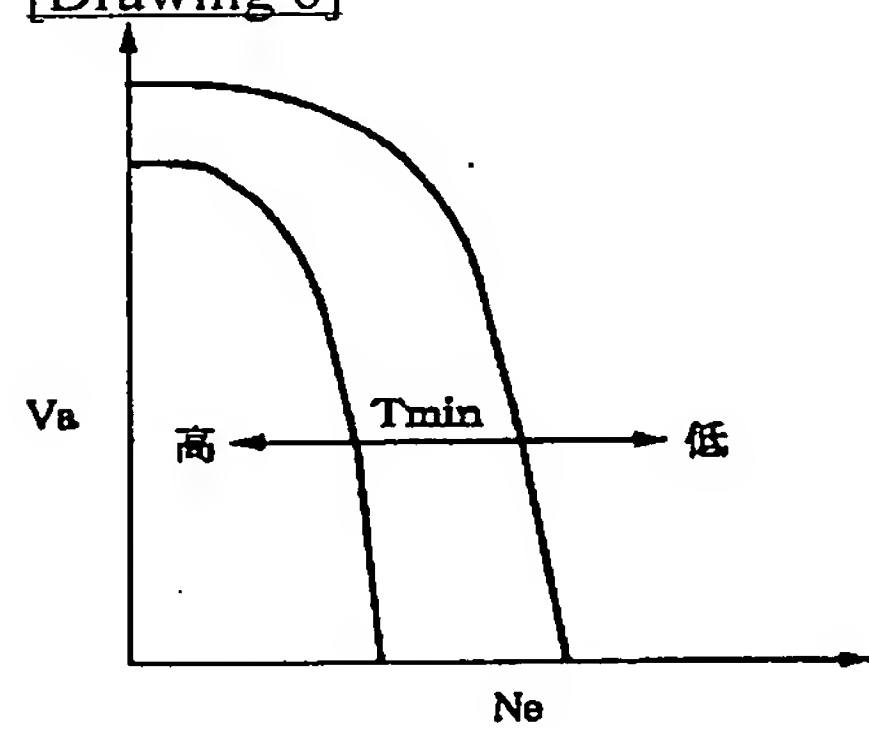
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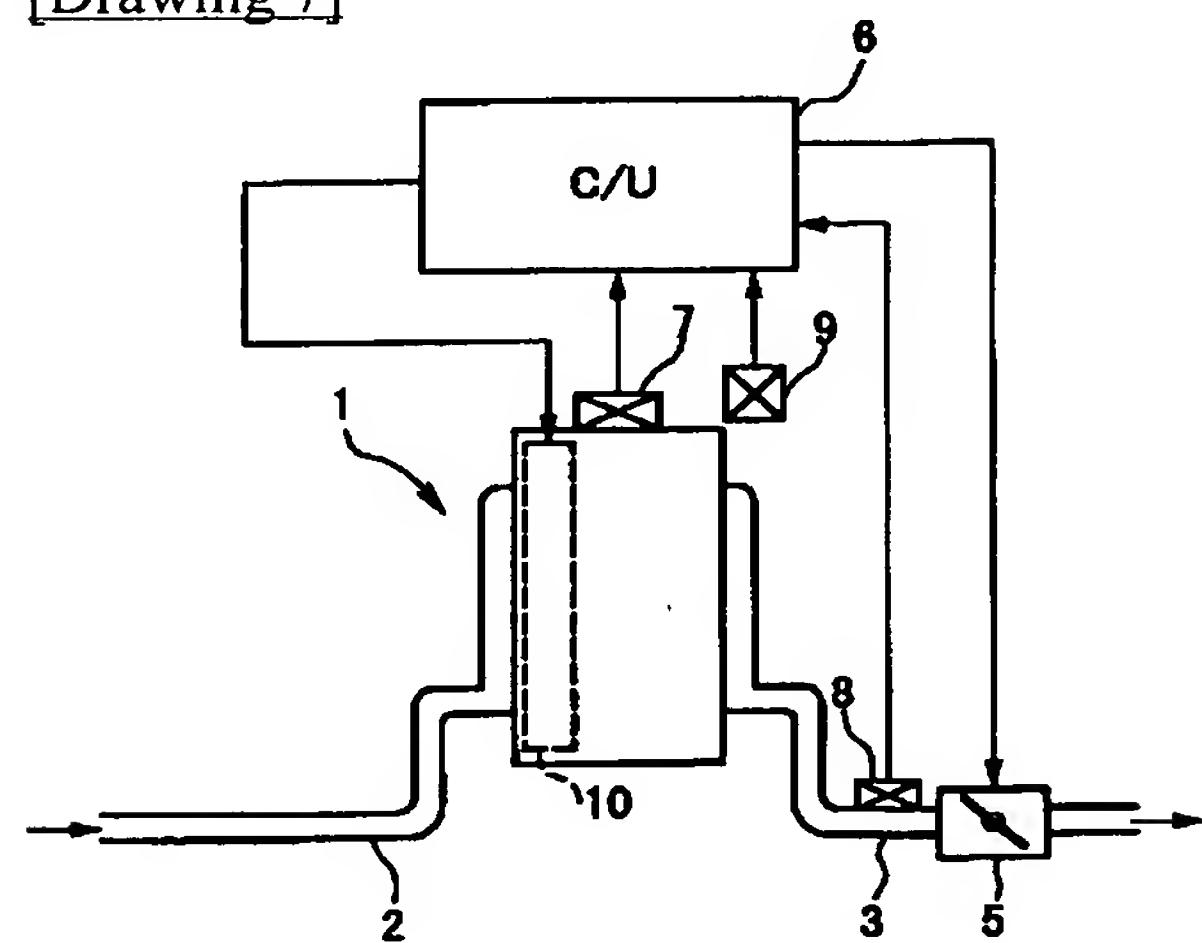
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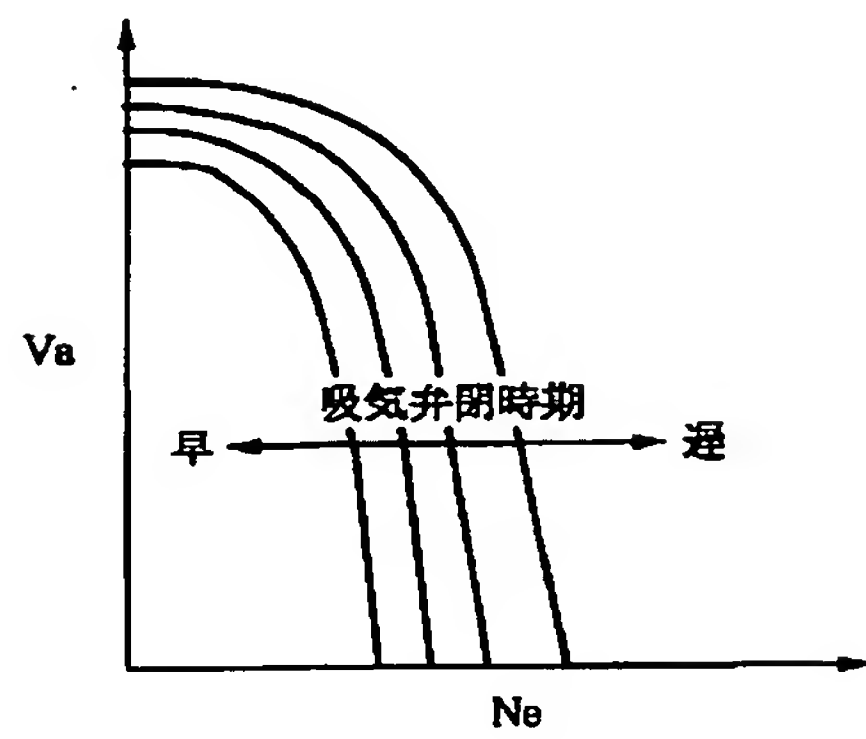
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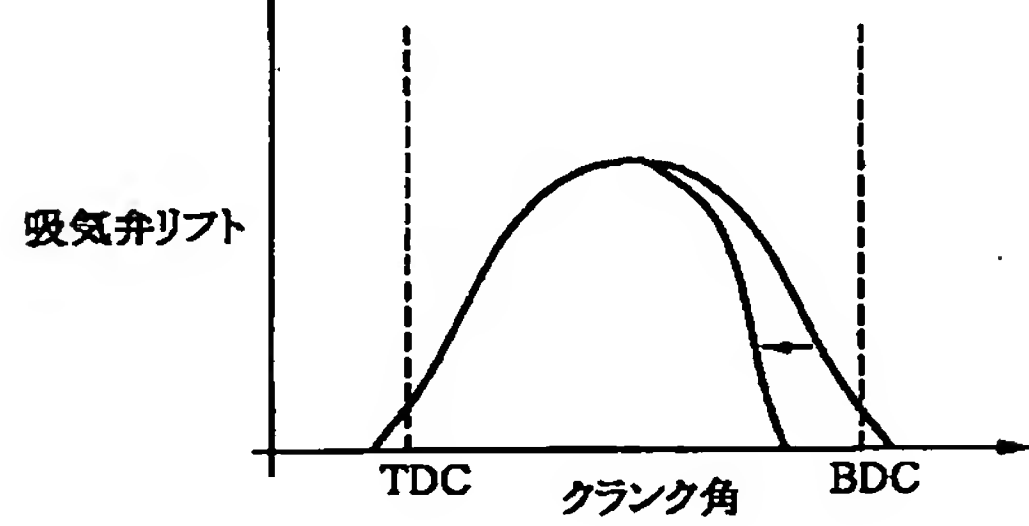
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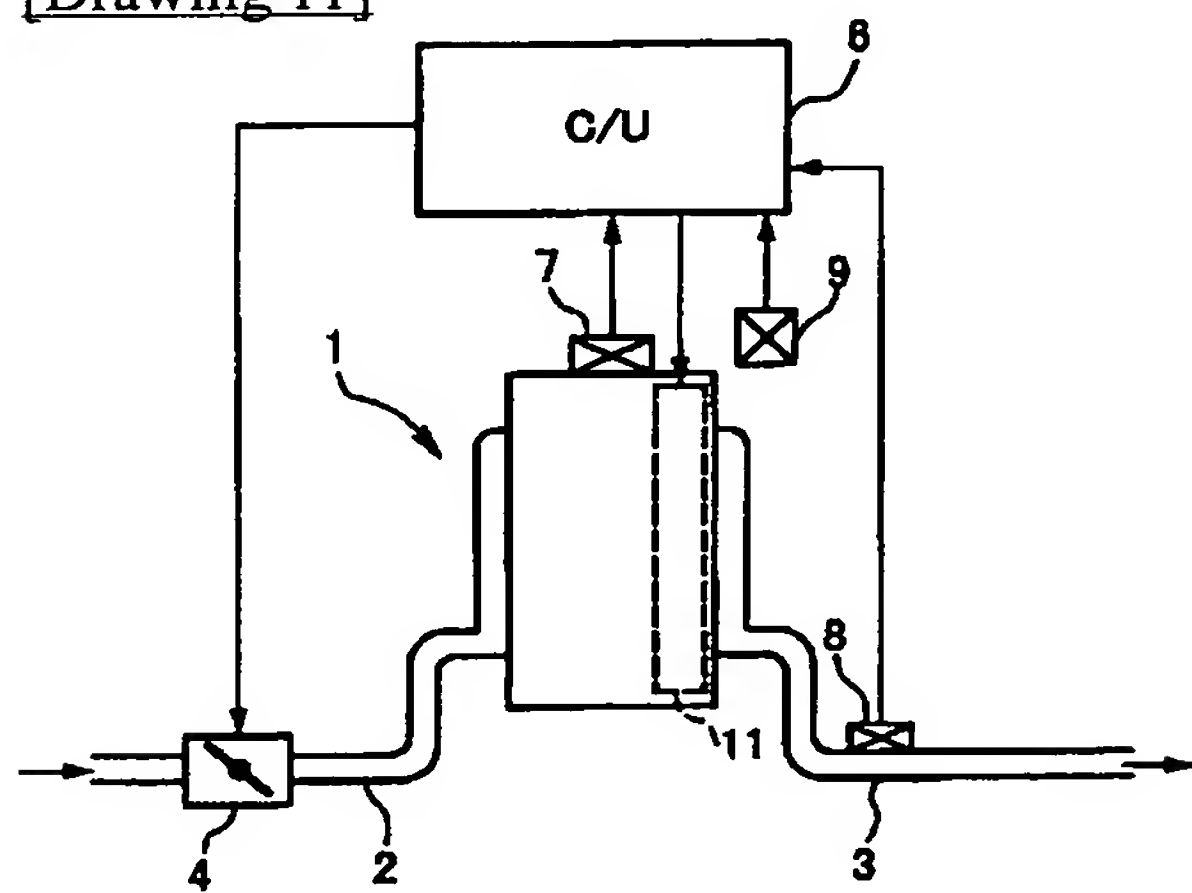
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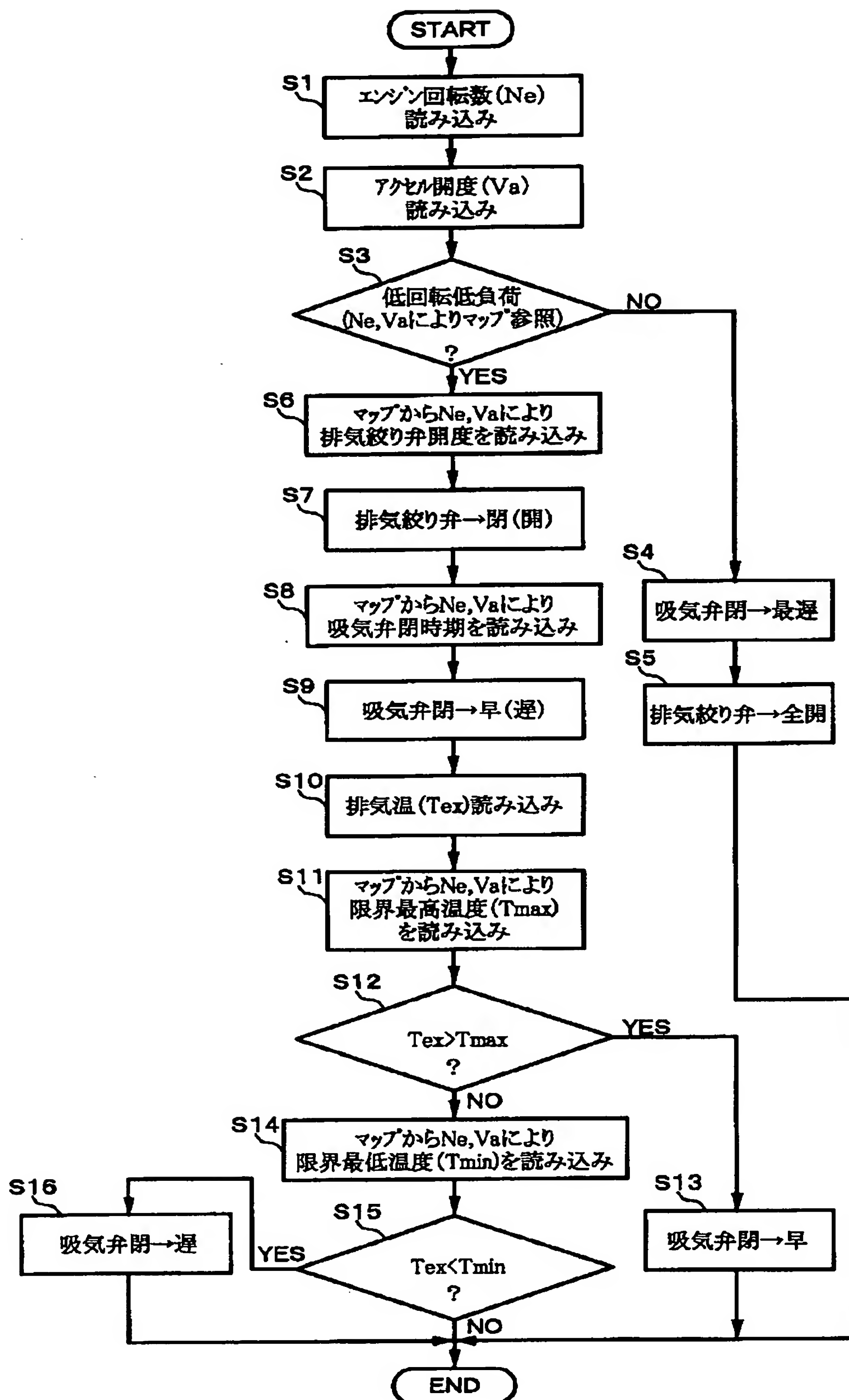
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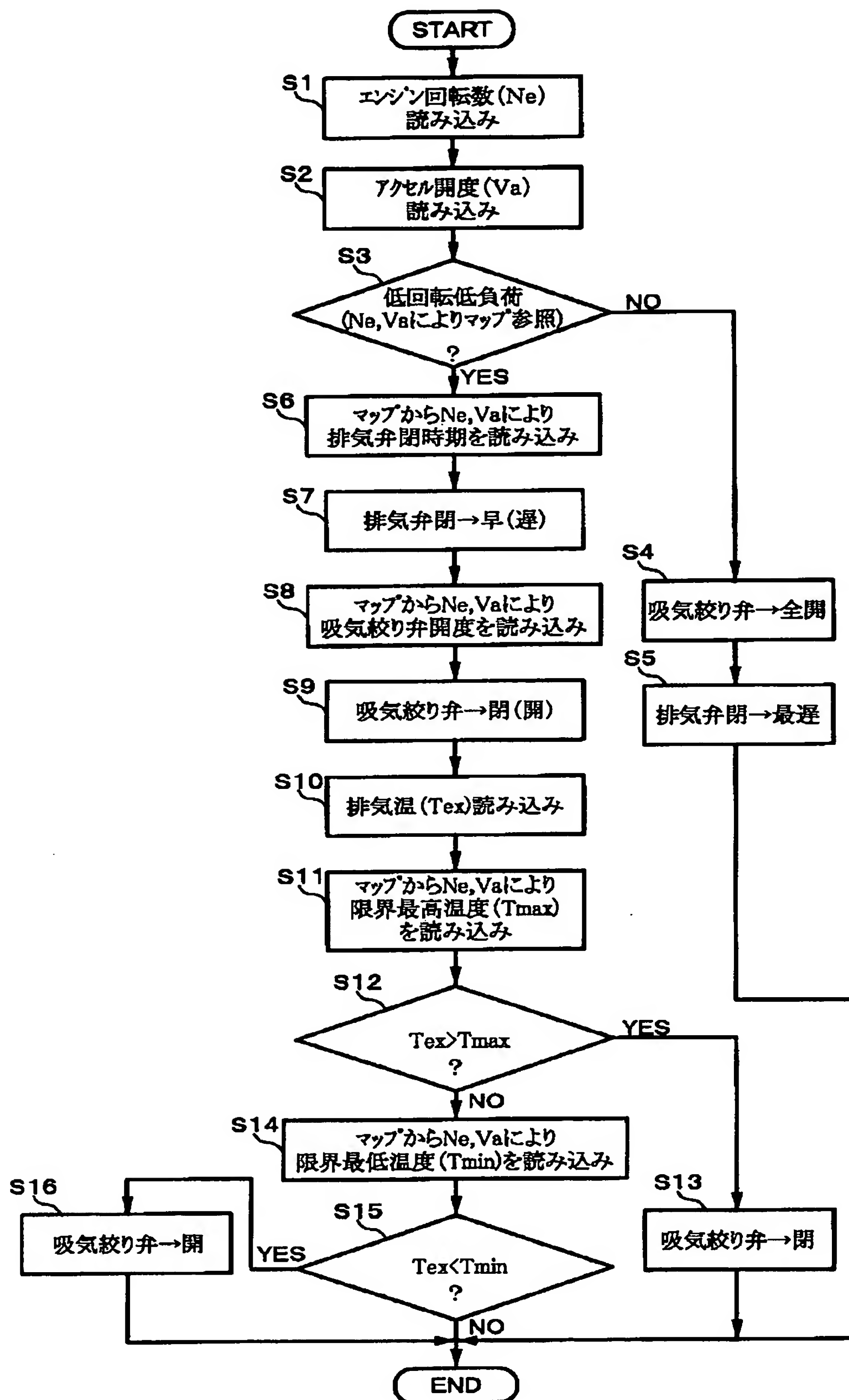
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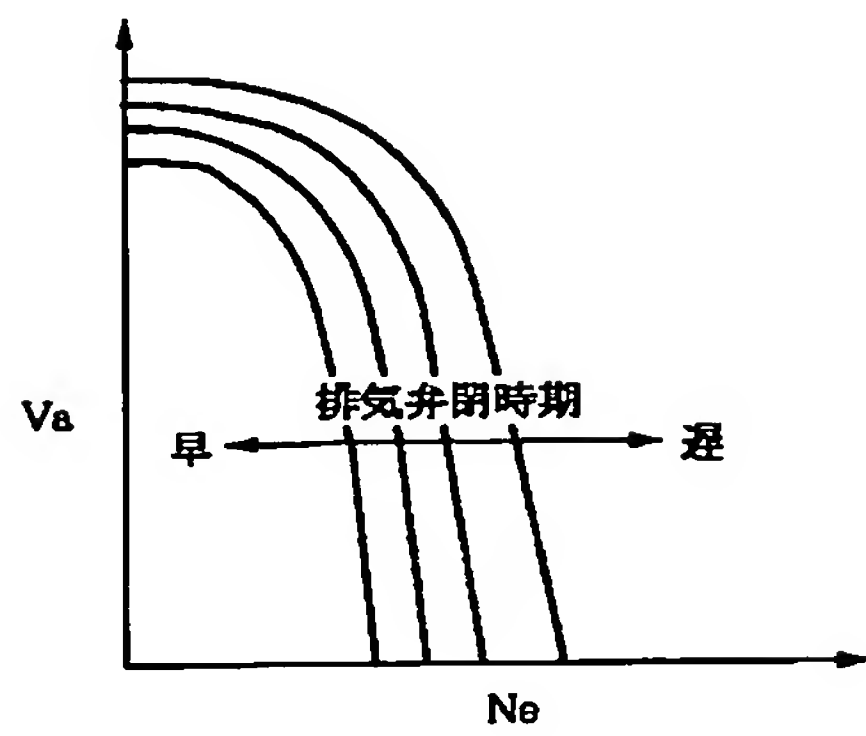
[Drawing 8]



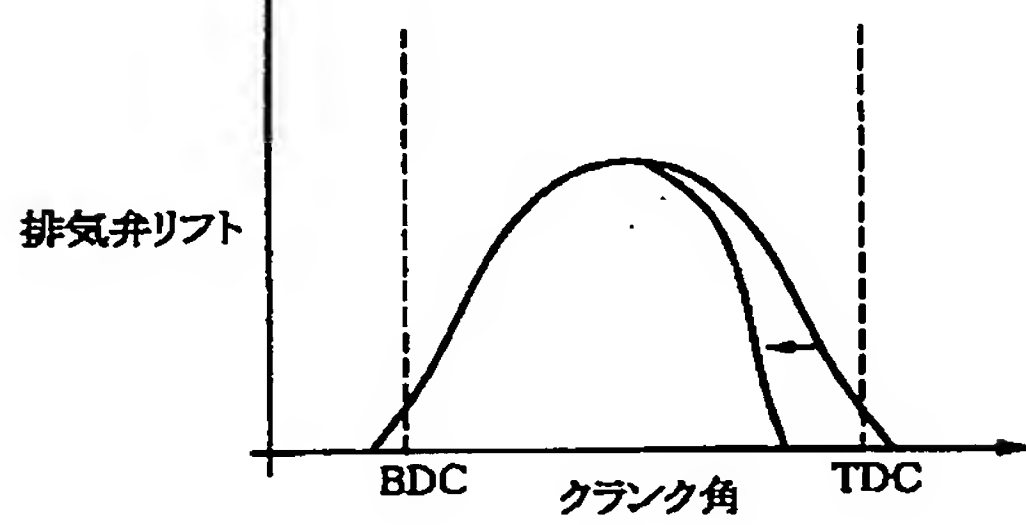
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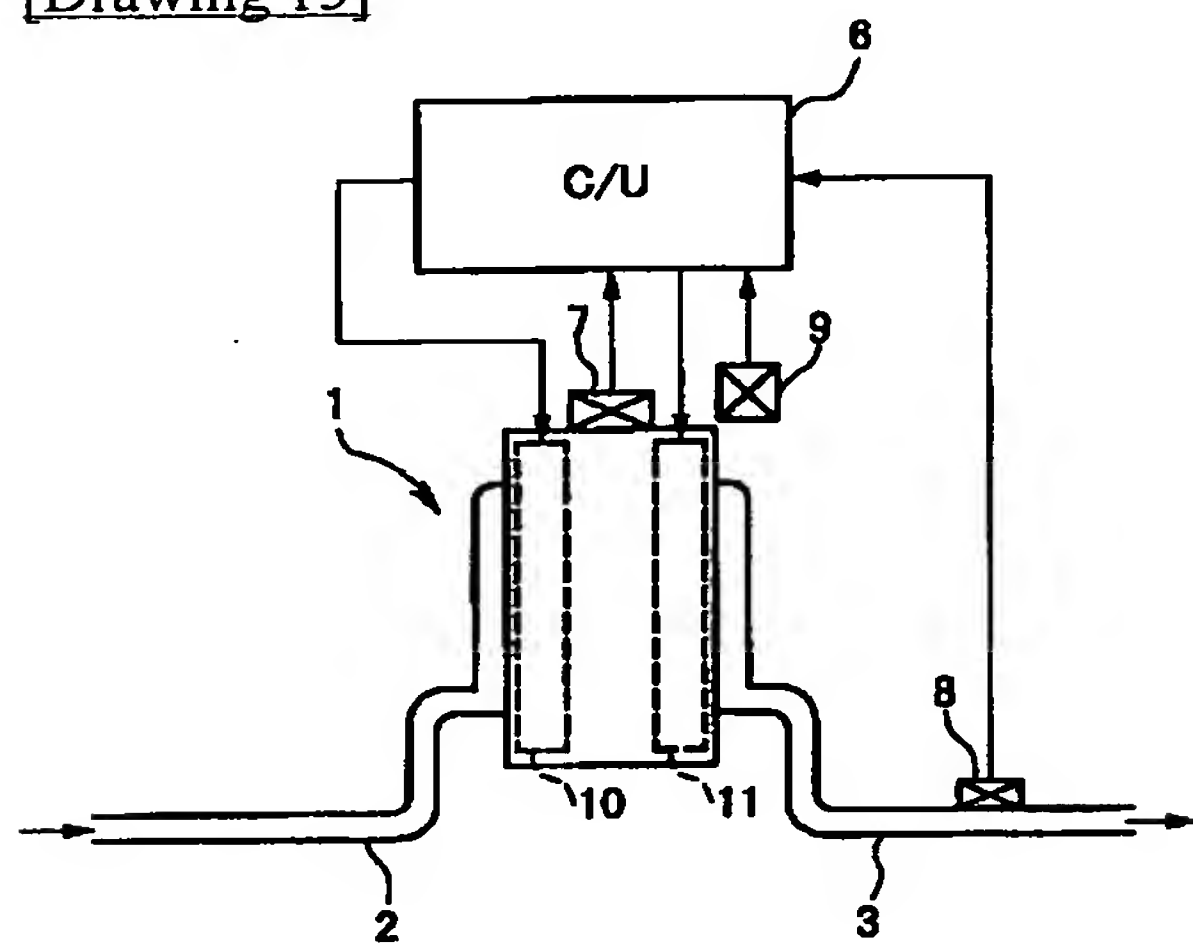
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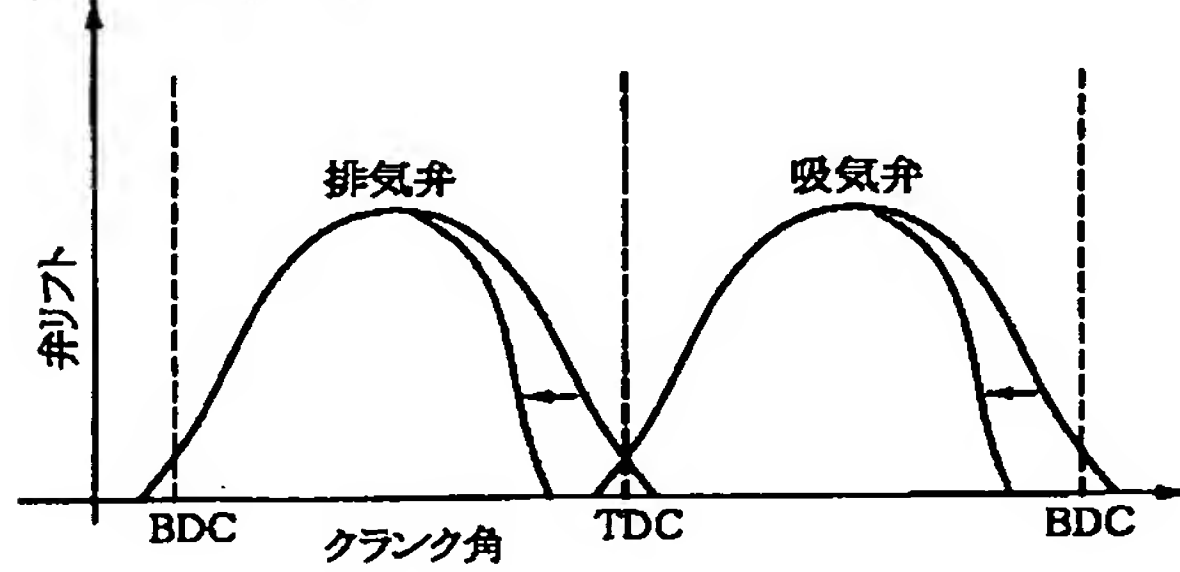
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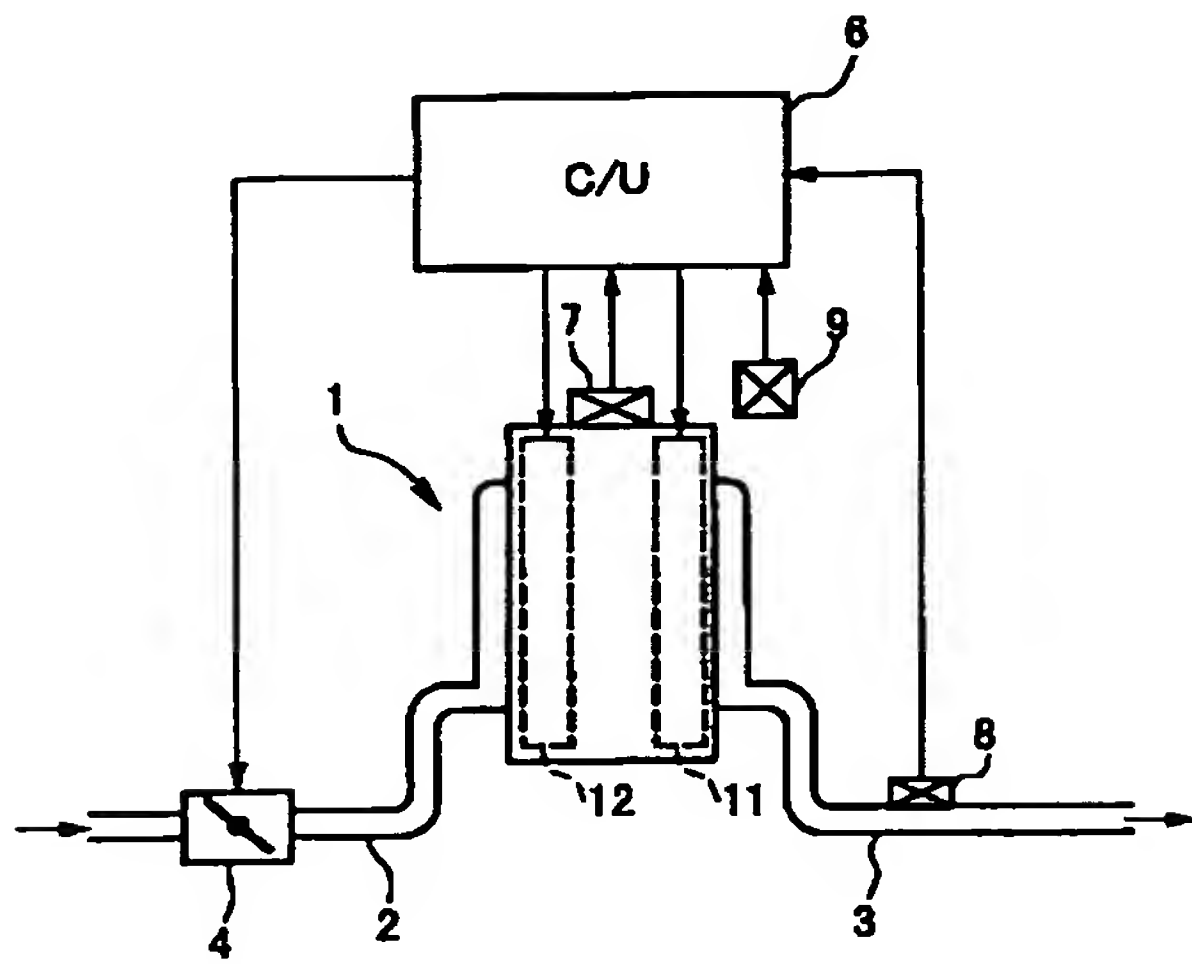
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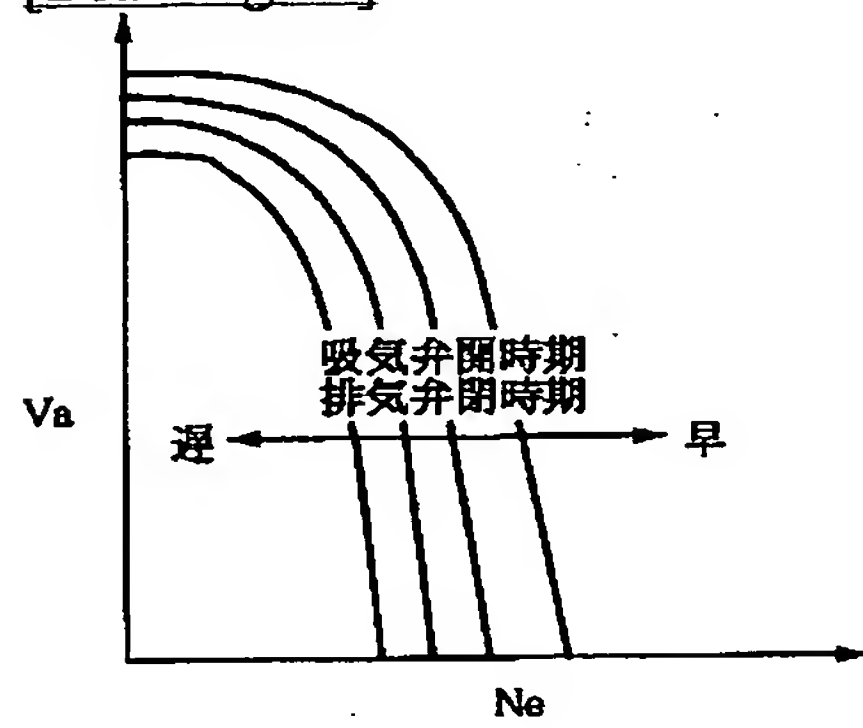
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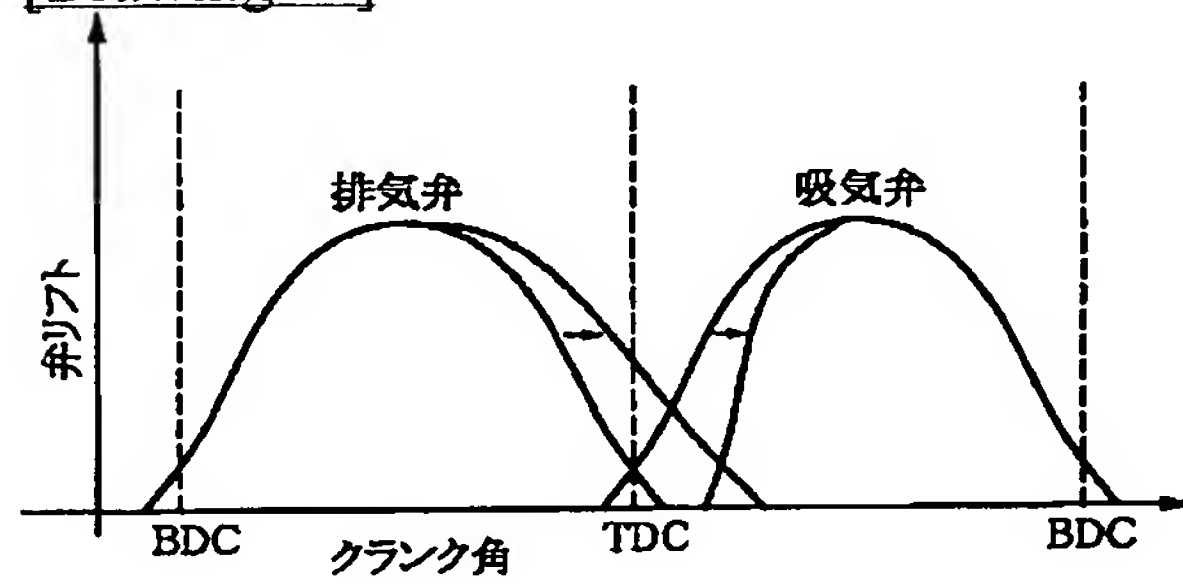
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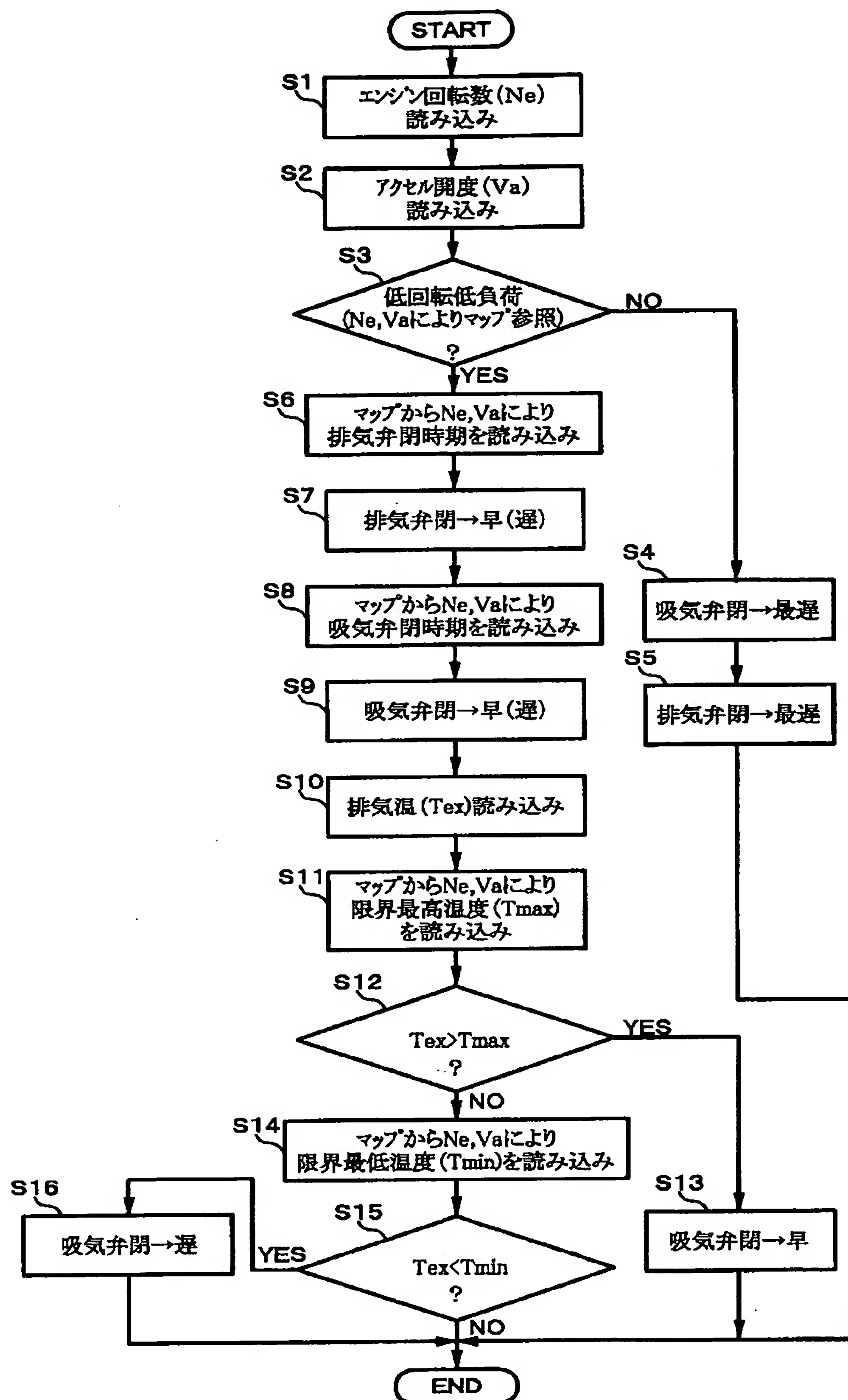
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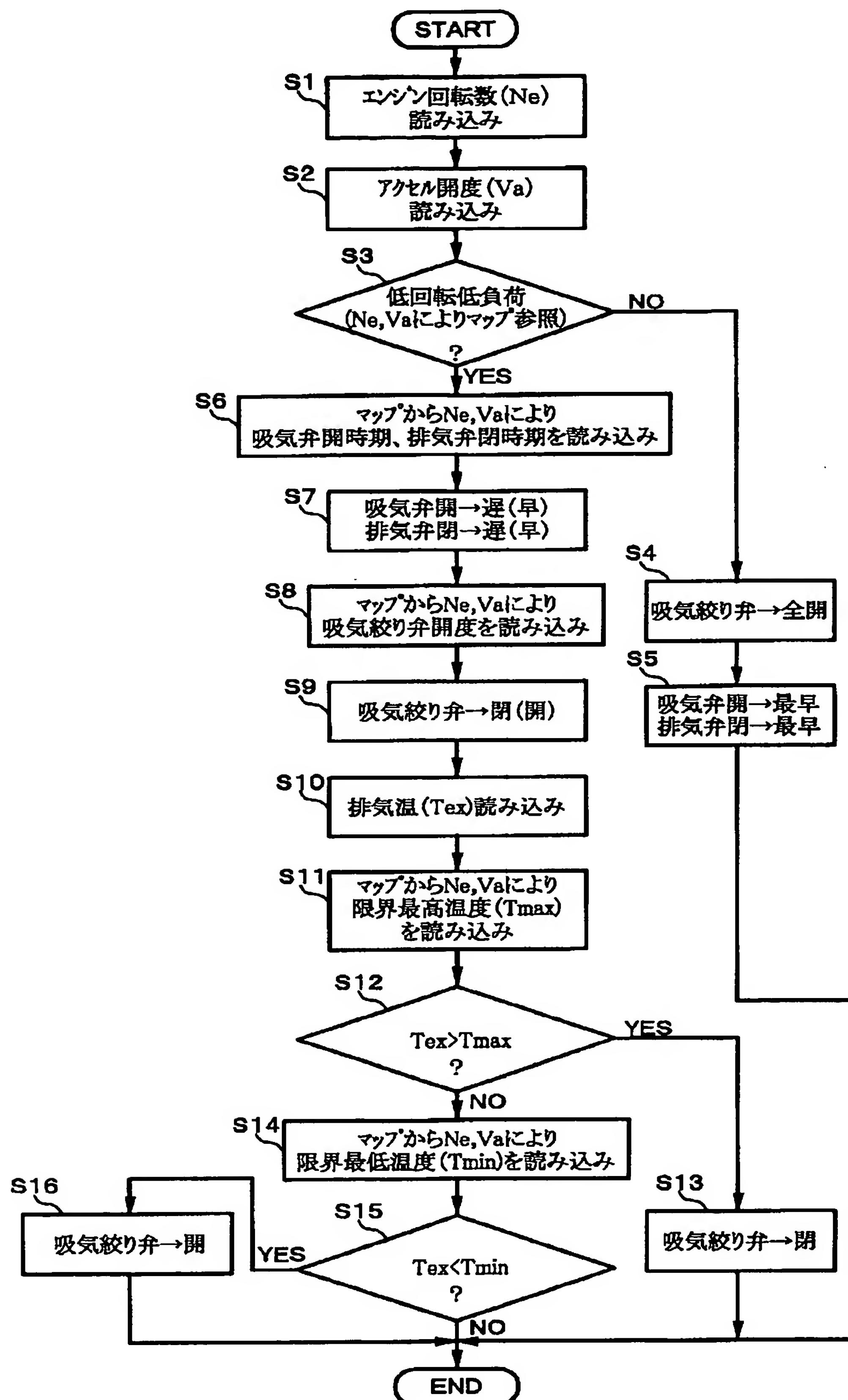
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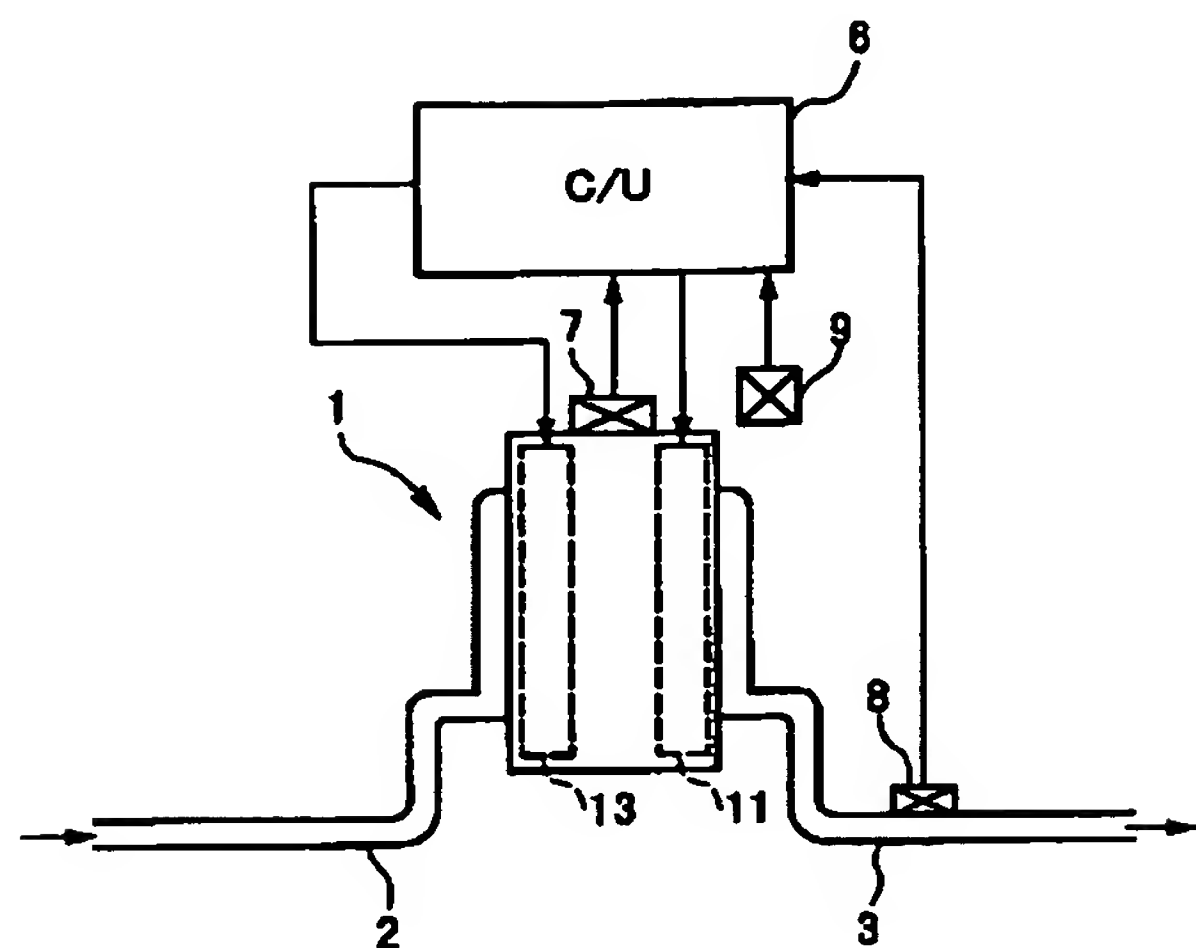
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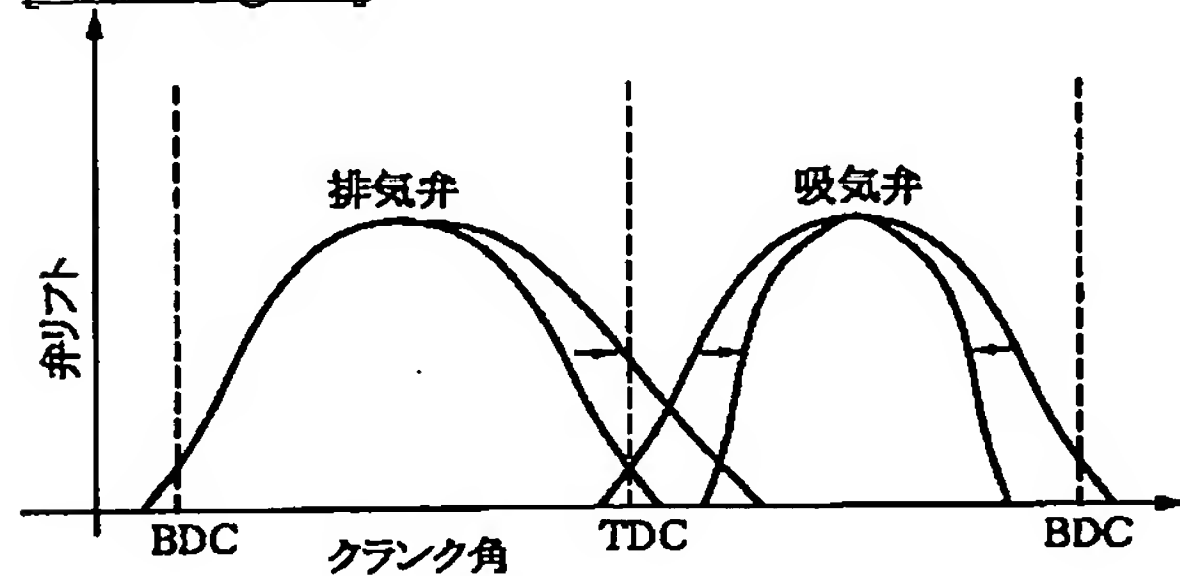
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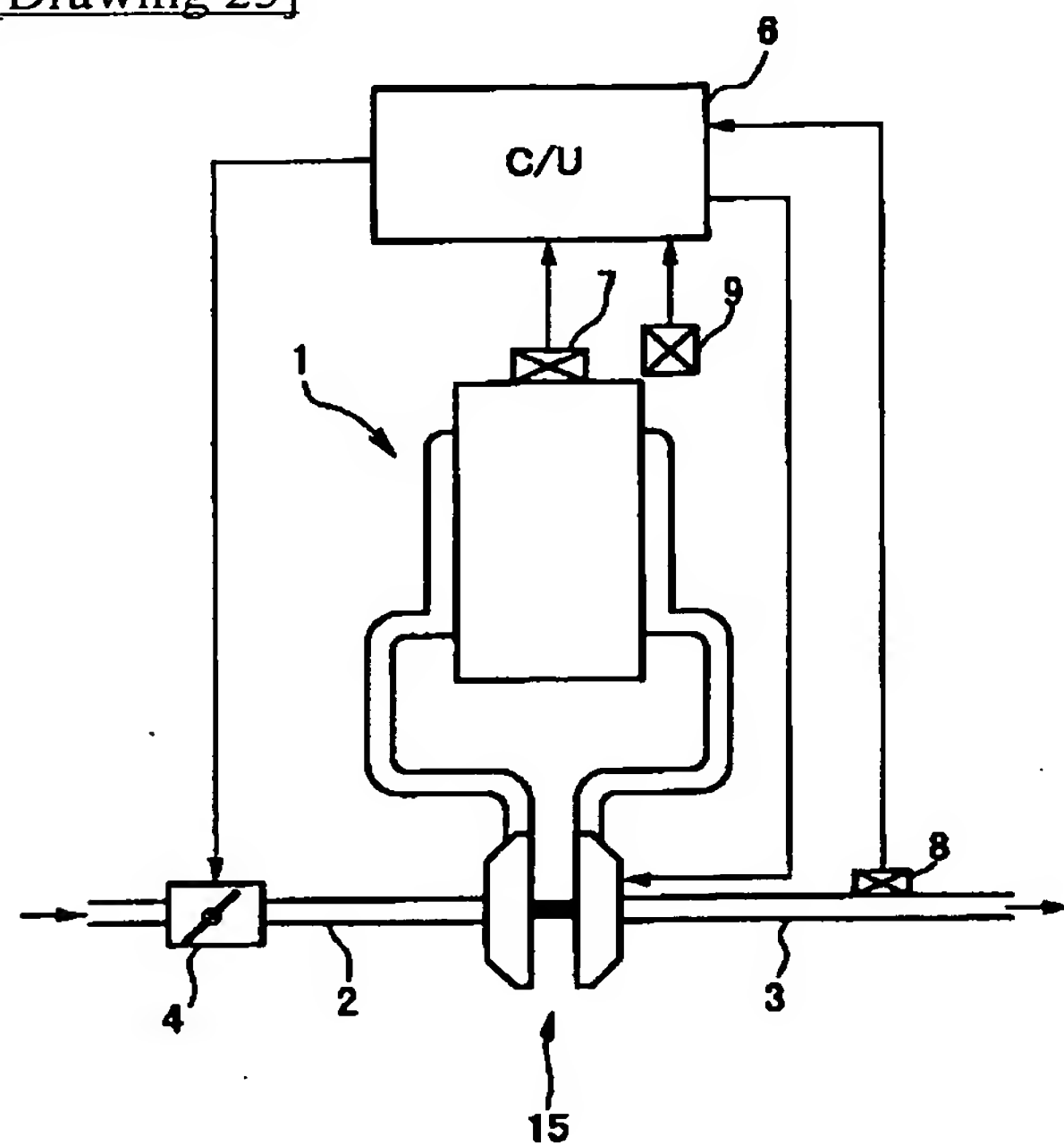
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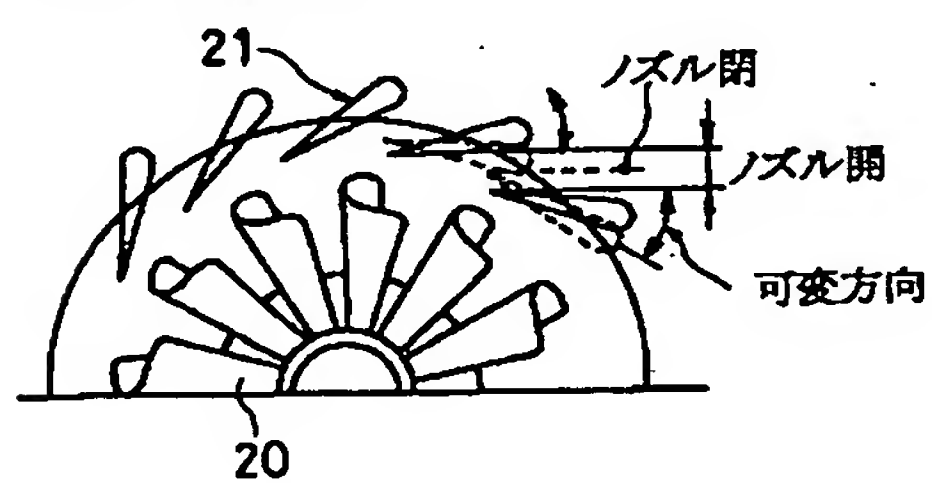
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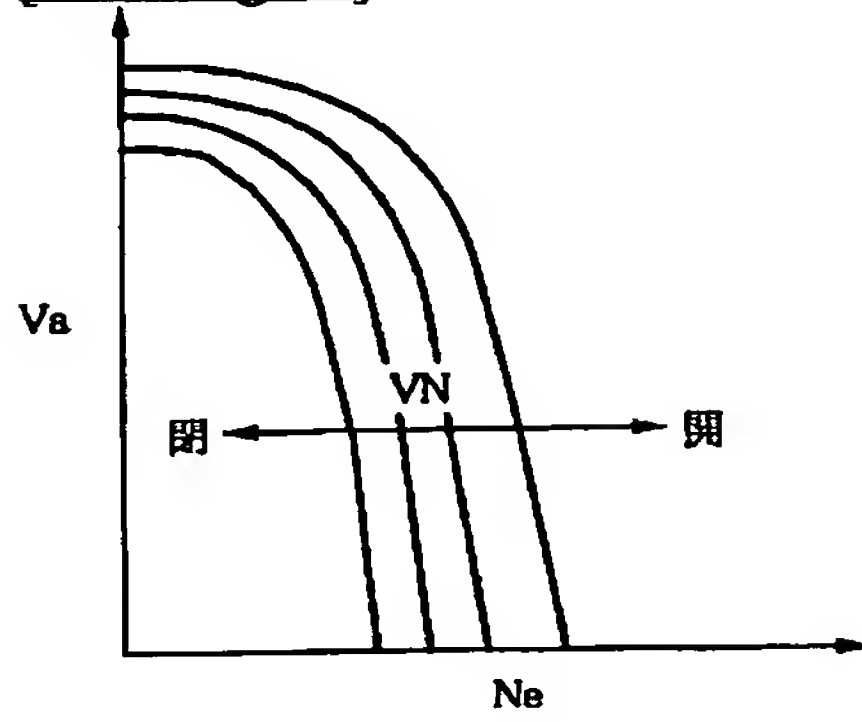
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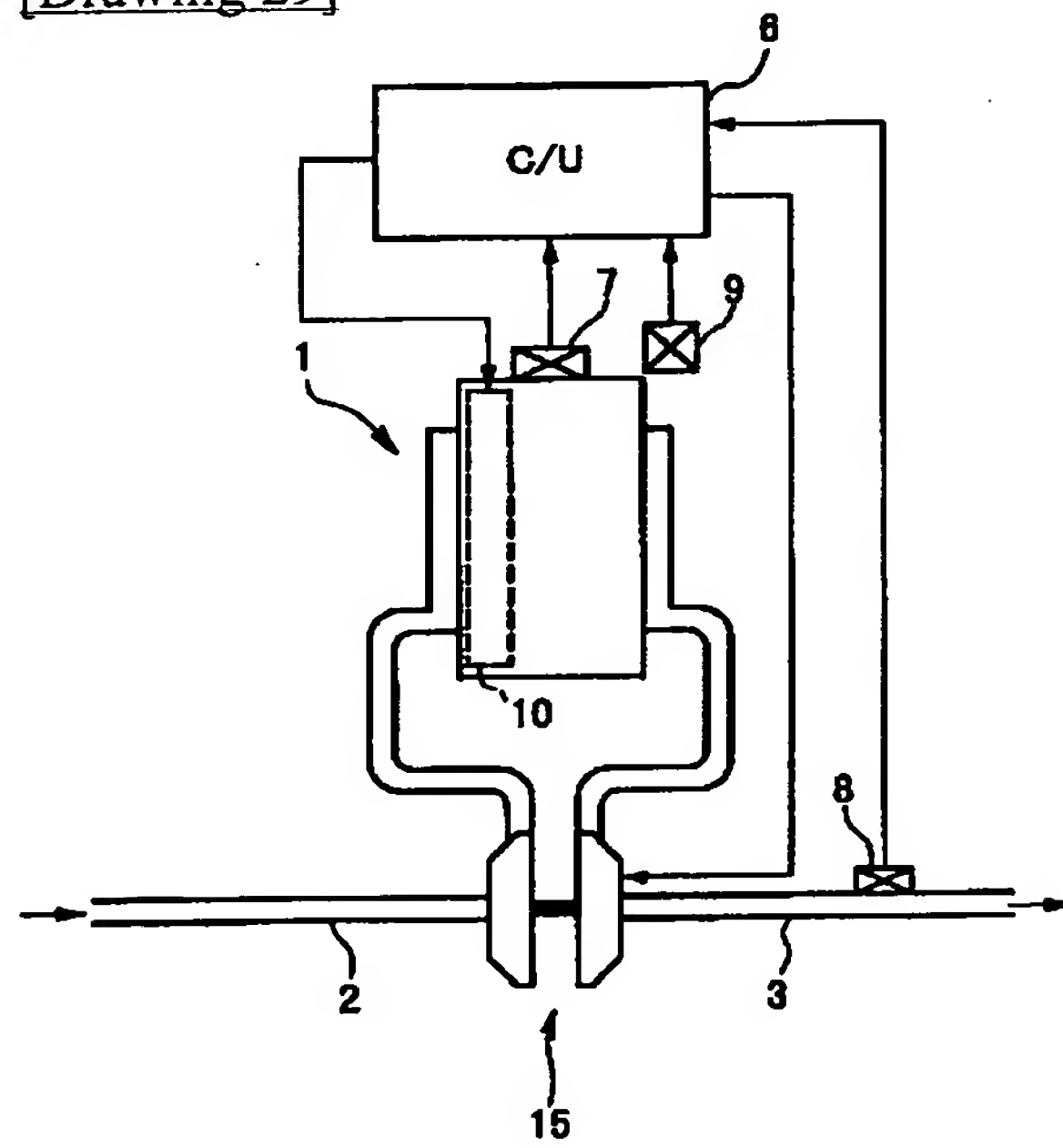
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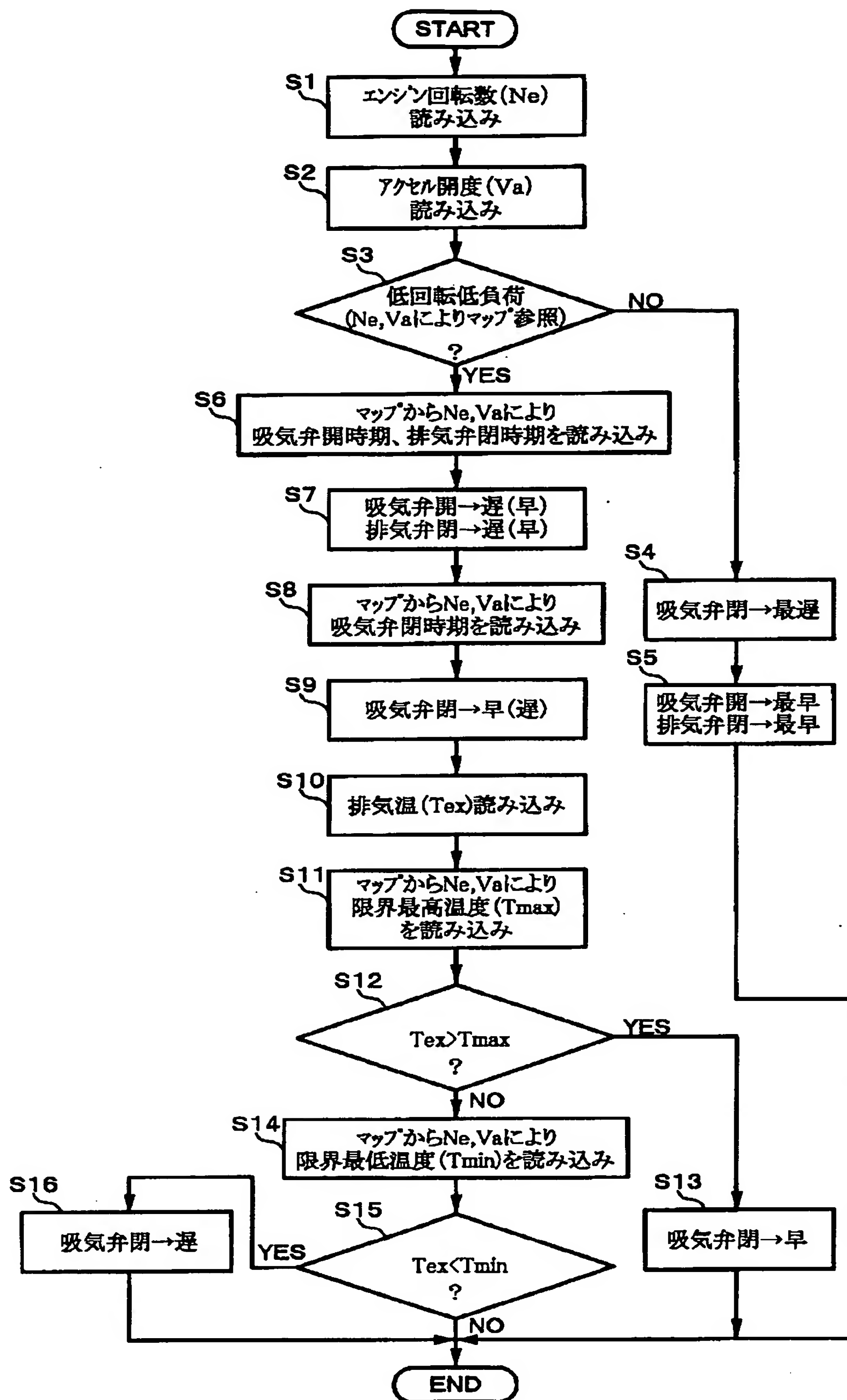
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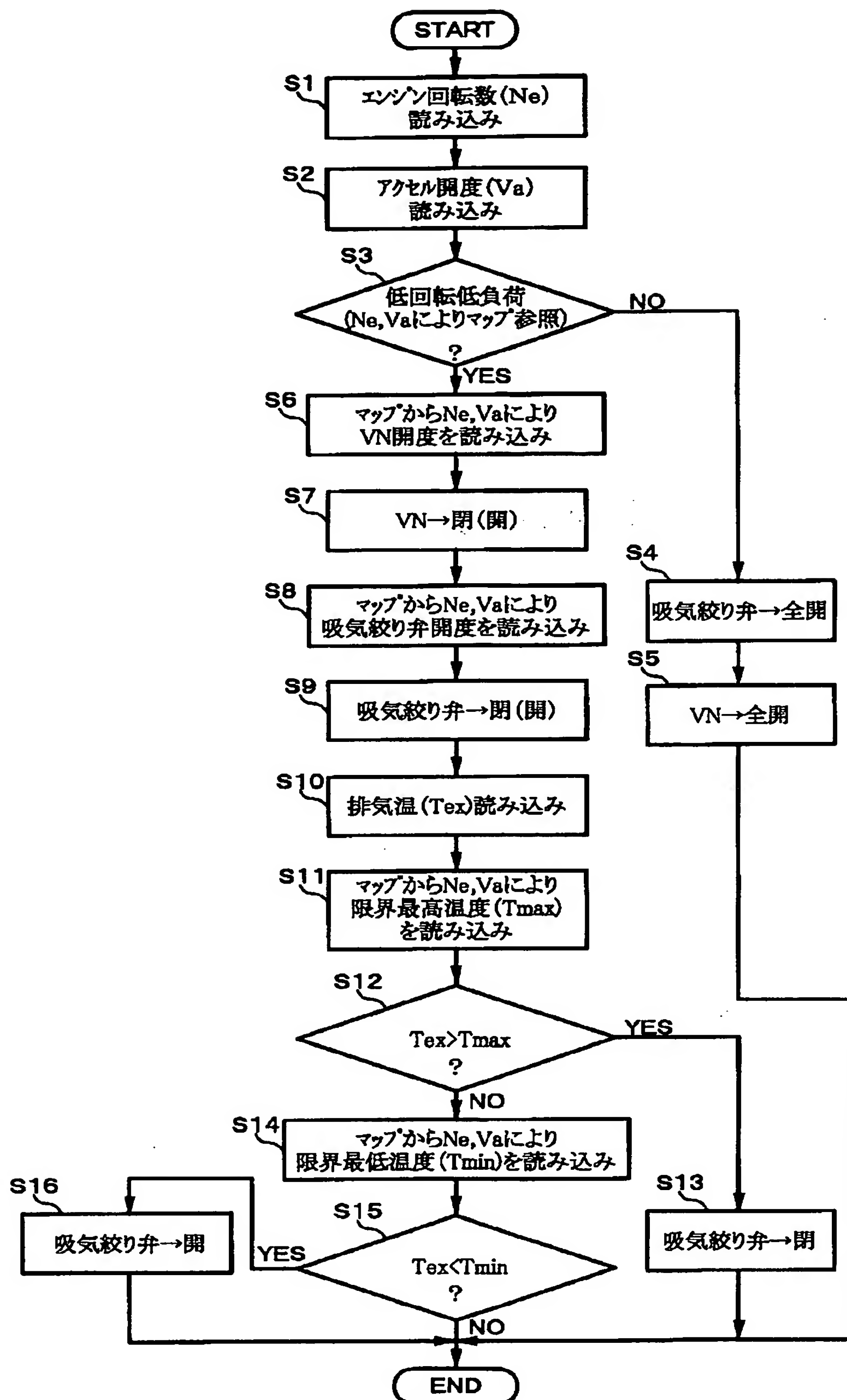
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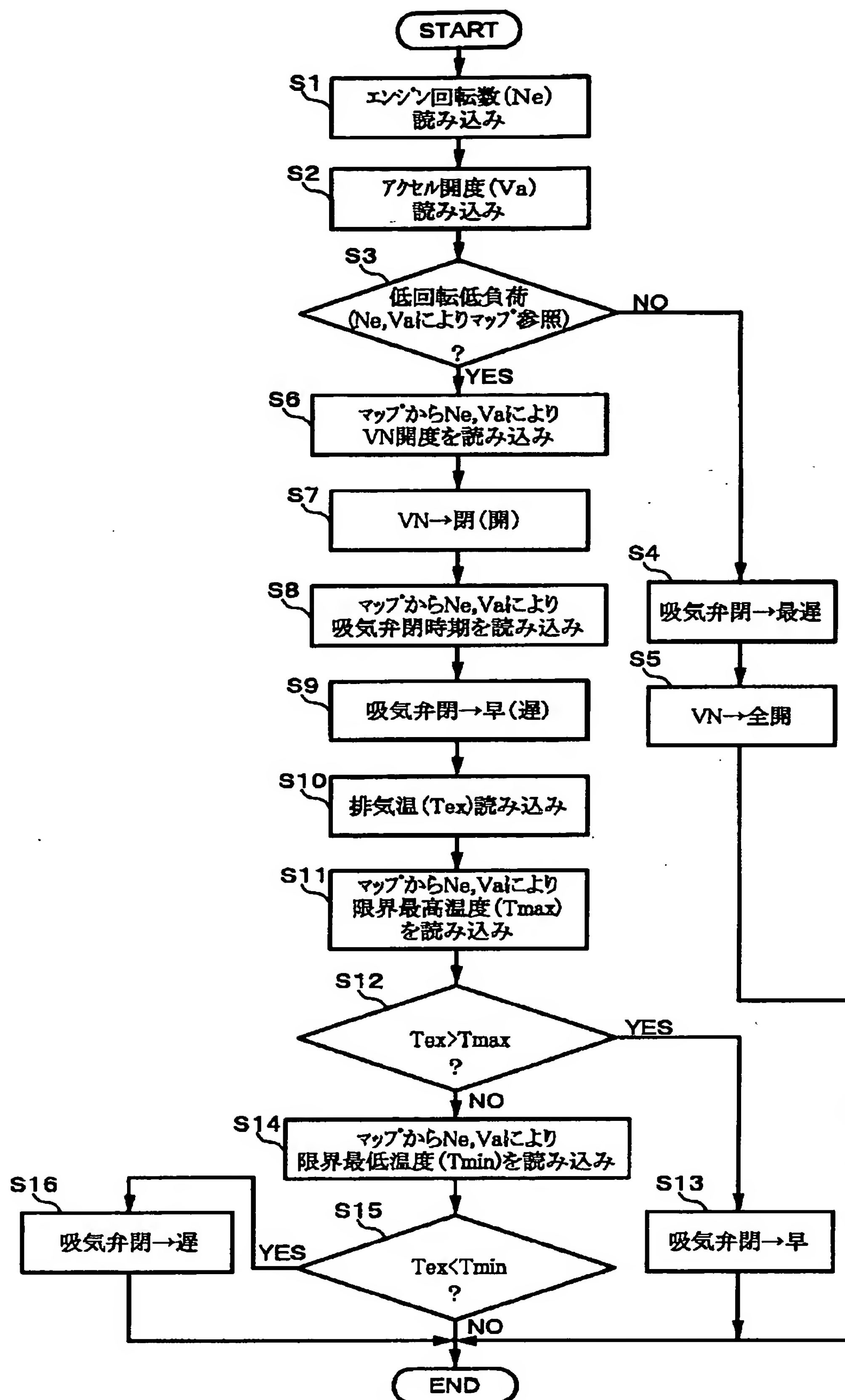
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[Drawing 27]



[Drawing 30]



[Translation done.]

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(71) 出願人 000003997

日産自動車株式会社

神奈川県横浜市神奈川区宝町2番地

(72) 発明者 青木 敦

神奈川県横浜市神奈川区宝町2番地 日産
自動車株式会社内

(72) 発明者 上原 哲也

神奈川県横浜市神奈川区宝町2番地 日産
自動車株式会社内

(74) 代理人 100078330

弁理士 笹島 富二雄

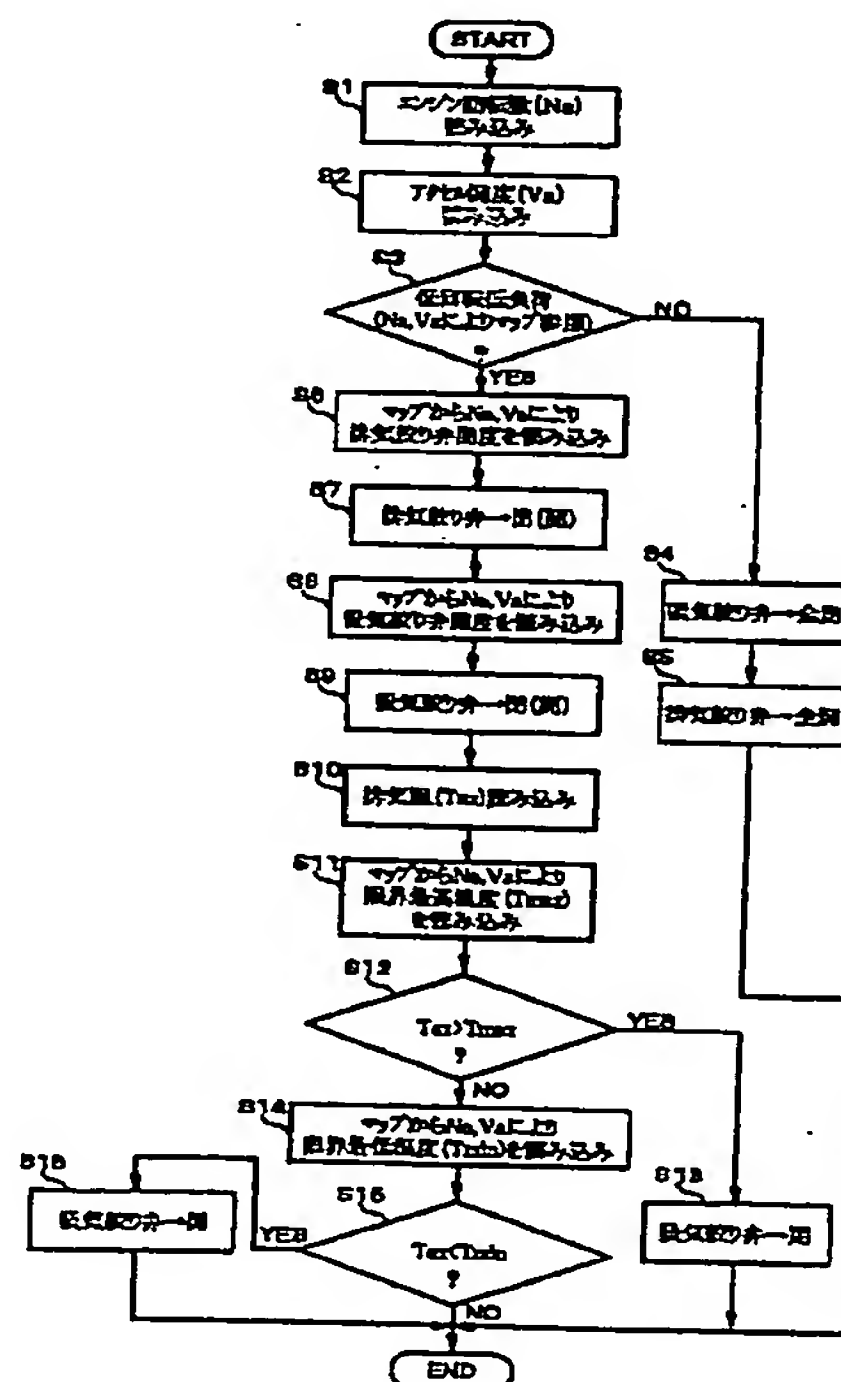
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(54) 【発明の名称】 圧縮着火機関

(57) 【要約】

【課題】 圧縮着火機関において、良好な燃焼を行える筒内温度を維持しつつ、低回転低負荷時の振動・騒音を低減する。

【解決手段】 圧縮着火機関の低回転低負荷領域で、吸気絞り弁の開度を回転及び負荷に応じて絞ることで筒内圧を低下させ (STEP 8, 9)、振動・騒音の低減を図ると同時に、排気絞り弁の開度を回転及び負荷に応じて絞ることで (STEP 6, 7)、残留ガス量を増加させ、以って、圧縮開始時の筒内温度を上昇させ、良好な燃焼を行える筒内温度を維持できるようにする。



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【特許請求の範囲】

【請求項1】圧縮開始時の筒内圧を低下させる筒内圧低下手段と、圧縮開始時の筒内温度を上昇させる筒内温度上昇手段とを備え、所定運転領域で前記筒内圧低下手段及び筒内温度上昇手段を同時に動作させることを特徴とする圧縮着火機関。

【請求項2】前記所定運転領域が低回転低負荷領域であることを特徴とする請求項1記載の圧縮着火機関。

【請求項3】前記筒内圧低下手段及び筒内温度上昇手段が、機関負荷及び機関回転速度に応じて、筒内圧を低下させる操作量及び筒内温度を上昇させる操作量をそれぞれ決定することを特徴とする請求項1又は2記載の圧縮着火機関。

【請求項4】前記筒内温度上昇手段が、排気行程終了時における筒内の残留ガス量を増大させることで、圧縮開始時の筒内温度を上昇させることを特徴とする請求項1～3のいずれか1つに記載の圧縮着火機関。

【請求項5】前記筒内温度上昇手段が、排気管に介装された絞り弁を絞ることで、排気行程終了時における筒内の残留ガス量を増大させることを特徴とする請求項4記載の圧縮着火機関。

【請求項6】前記筒内温度上昇手段が、排気弁の開時期を早めることで、排気行程終了時における筒内の残留ガス量を増大させることを特徴とする請求項4記載の圧縮着火機関。

【請求項7】前記筒内温度上昇手段が、排気弁の開時期を遅延させ、かつ、吸気弁の開時期を遅延させることで、排気行程終了時における筒内の残留ガス量を増大させることを特徴とする請求項4記載の圧縮着火機関。

【請求項8】前記筒内温度上昇手段が、排気管に備えられた排気タービンへ排気を導くノズルの流路面積を絞ることで、排気行程終了時における筒内の残留ガス量を増大させることを特徴とする請求項4記載の圧縮着火機関。

【請求項9】前記筒内圧低下手段が、吸気管に介装された絞り弁を絞ることで、圧縮開始時の筒内圧を低下させることを特徴とする請求項1～8のいずれか1つに記載の圧縮着火機関。

【請求項10】前記筒内圧低下手段が、吸気弁の開時期を変化させることで、圧縮開始時の筒内圧を低下させることを特徴とする請求項1～8のいずれか1つに記載の圧縮着火機関。

【請求項11】排気温度が限界最高温度以下でかつ限界最低温度以上になるように、前記筒内温度上昇手段又は前記筒内圧低下手段の操作量を補正する補正制御手段を設けたことを特徴とする請求項3～10のいずれか1つに記載の圧縮着火機関。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は圧縮着火機関に関

し、詳しくは、圧縮着火機関における振動・騒音を低減するための技術に関する。

【0002】

【従来の技術】圧縮着火機関（ディーゼルエンジン）は、火花点火機関（ガソリンエンジン）に比べて熱効率が低い反面、特にアイドリング等の低回転低負荷時における振動・騒音が大きいという特性がある。

【0003】燃焼混合気の空燃比を略一定に保って運転する火花点火機関では、出力の調整は混合気量すなわち吸気量の調整によって行われる。従って、低負荷時には吸気管を絞って吸気量を減らすため、筒内圧が低下する。

【0004】これに対し、圧縮着火機関では、吸気量を調整せずに、燃料噴射量で出力を調整する構成であるため、低負荷時の筒内圧が火花点火機関よりも大きくなり、これが、アイドリング等の低回転低負荷時において振動・騒音が火花点火機関よりも大きくなる原因となっていた。

【0005】このような圧縮着火機関における低回転低負荷時の振動・騒音を低減する方法として、火花点火機関と同様に吸気管に絞り弁を設けて、低負荷時に吸気絞りを行うことで筒内圧を低下させる方法があった（特開平8-061097号公報参照）。

【0006】

【発明が解決しようとする課題】ところで、化学反応である燃料の着火には、温度及び圧力が影響を及ぼすが、化学反応の反応速度は温度に対して指数関数的に変化することから、燃料の着火においては温度の影響が支配的となる。

【0007】一方、上記のように、低負荷時に吸気絞りを行って筒内圧を低下させると、同時に筒内温度が低下することから、ある程度以上に吸気絞りを行くと、圧縮上死点付近の筒内温度が低下し、着火しなくなったり、完全に失火しない場合でもエミッションの悪化（HC、スモークの排出）を招く。

【0008】そのため、着火性能を確保するために吸気絞り量を制限する必要が生じ、振動や騒音を火花点火機関と同程度にまで低減させることが困難であるという問題があった。

【0009】本発明は上記問題点に鑑みなされたものであり、圧縮着火機関において、低回転低負荷時の振動・騒音を十分に低下させ得る程度に筒内圧を低下させつつ、着火性能を確保できるようにすることを目的とする。

【0010】

【課題を解決するための手段】そのため請求項1記載の発明では、圧縮開始時の筒内圧を低下させる筒内圧低下手段と、圧縮開始時の筒内温度を上昇させる筒内温度上昇手段とを備え、所定運転領域で前記筒内圧低下手段及び筒内温度上昇手段を同時に動作させる構成とした。

【0011】かかる構成によると、筒内圧低下手段により圧縮開始時（吸気行程終了時）の筒内圧を低下させるときに、同時に、圧縮開始時（吸気行程終了時）の筒内温度を上昇させる筒内温度上昇手段を動作させ、筒内圧の低下に伴う筒内温度低下が、筒内温度上昇手段の動作で補われ、圧縮着火に必要な筒内温度が確保されるようにする。

【0012】請求項2記載の発明では、前記所定運転領域を低回転低負荷領域とする構成とした。かかる構成によると、アイドリング等の低回転低負荷領域において、10 筒内圧を低下させつつ、筒内温度の上昇を図る。

【0013】請求項3記載の発明では、前記筒内圧低下手段及び筒内温度上昇手段が、機関負荷及び機関回転速度に応じて、筒内圧を低下させる操作量及び筒内温度を上昇させる操作量をそれぞれ決定する構成とした。

【0014】かかる構成によると、圧縮開始時の筒内圧を低下させると同時に、圧縮開始時の筒内温度を上昇させるように制御される所定の運転領域内（低回転低負荷領域）において、機関負荷及び機関回転速度に応じた操作量に基づき筒内圧の低下及び筒内温度の上昇が制御される。20

【0015】請求項4記載の発明では、前記筒内温度上昇手段が、排気行程終了時における筒内の残留ガスを増大させることで、圧縮開始時の筒内温度を上昇させる構成とした。

【0016】かかる構成によると、排気行程で排出されずに筒内に残る残留ガス量（内部EGR量）を増大させることで、排気行程終了時における筒内温度を高くし、以って、圧縮開始時の筒内温度を上昇させる。

【0017】請求項5記載の発明では、前記筒内温度上昇手段が、排気管に介装された絞り弁を絞ることで、排気行程終了時における筒内の残留ガスを増大させる構成とした。30

【0018】かかる構成によると、排気管に介装された絞り弁を絞ることで、排気抵抗が増して残留ガス量が増大し、圧縮開始時の筒内温度が上昇する。請求項6記載の発明では、前記筒内温度上昇手段が、排気弁の開時期を早めることで、排気行程終了時における筒内の残留ガスを増大させる構成とした。

【0019】かかる構成によると、排気弁の開時期が早められることで筒内から排出されるガス量が減り、相対的に残留ガス量が増え、圧縮開始時の筒内温度が上昇する。請求項7記載の発明では、前記筒内温度上昇手段が、排気弁の開時期を遅延させ、かつ、吸気弁の開時期を遅延させることで、排気行程終了時における筒内の残留ガスを増大させる構成とした。40

【0020】かかる構成によると、排気弁の開時期を遅延させてTDC以降での排気弁の開期間を長くし、かつ、吸気弁の開時期を遅延させてオーバーラップをなくせば、一旦排出された排気が筒内に戻るようにでき、こ50

れにより残留ガス量が増え、圧縮開始時の筒内温度が上昇する。

【0021】請求項8記載の発明では、前記筒内温度上昇手段が、排気管に備えられた排気タービンへ排気を導くノズルの流路面積を絞ることで、排気行程終了時における筒内の残留ガスを増大させる構成とした。

【0022】かかる構成によると、排気ターボチャージャの排気タービンが排気管に備えられ、かつ、該排気タービンへ排気を導くノズルの流路面積が可変に構成されるときに、前記ノズルの流路面積を絞ることで排気抵抗を増加させ、これにより、残留ガスを増加させ、圧縮開始時の筒内温度を上昇させる。

【0023】請求項9記載の発明では、前記筒内圧低下手段が、吸気管に介装された絞り弁を絞ることで、圧縮開始時の筒内圧を低下させる構成とした。かかる構成によると、吸気管に介装された絞り弁を絞ることで、吸気行程において絞り弁下流側の吸気管内が負圧となり、圧縮開始時（吸気終了時）の筒内圧が低下する。

【0024】請求項10記載の発明では、前記筒内圧低下手段が、吸気弁の開時期を変化させることで、圧縮開始時の筒内圧を低下させる構成とした。かかる構成によると、吸気弁の開時期を早めて下死点前に閉じれば、吸気量が減少して圧縮開始時（吸気行程終了時）の筒内圧が低下し、また、吸気弁の開時期を下死点以降に遅くすれば、一旦筒内に吸引された空気がピストンの上昇に伴って排出されて吸気量が減少して圧縮開始時（吸気行程終了時）の筒内圧が低下する。

【0025】請求項11記載の発明では、排気温度が限界最高温度以下でかつ限界最低温度以上になるように、前記筒内温度上昇手段又は前記筒内圧低下手段の操作量を補正する補正制御手段を設ける構成とした。

【0026】かかる構成によると、排気温度が限界最高温度よりも高い場合には、圧縮開始時の筒内温度を低下させるべく、筒内温度上昇手段又は前記筒内圧低下手段の操作量が補正される一方、排気温度が限界最低温度よりも低い場合には、着火安定性の確保のために、圧縮開始時の筒内温度を増加させるべく、筒内温度上昇手段又は前記筒内圧低下手段の操作量が補正される。

【0027】

【発明の効果】請求項1記載の発明によると、筒内圧の低下による温度低下を補うように筒内温度を上昇させて着火安定性を維持するので、HC、スモークの排出を抑制しつつ、所定運転領域での振動・騒音を低減させることができるという効果がある。

【0028】請求項2記載の発明によると、圧縮着火機関で特に振動・騒音が問題となるアイドリング等の低回転低負荷時において、HC、スモークの排出を抑制しつつ、振動・騒音を低減させることができるという効果がある。

【0029】請求項3記載の発明によると、運転条件に

応じた適正な操作量に基づき、運転性に影響を与えることなく、振動・騒音を低減させることができるという効果がある。

【0030】請求項4記載の発明によると、残留ガス量を増やすことで、圧縮開始時の筒内温度を積極的に高くすることができ、筒内圧を低下させることによる筒内温度の低下を補って、着火安定性を維持できる温度に維持できるという効果がある。

【0031】請求項5記載の発明によると、簡易な構造の排気絞り弁を用いることで、コストの増大を抑えながら残留ガス量を増やして、圧縮開始時の筒内温度を上昇させることができるという効果がある。

【0032】請求項6, 7記載の発明によると、排気弁の開時期の制御により、残留ガス量を応答良く制御することができ、圧縮開始時の筒内温度を応答良く上昇させて、着火安定性を維持できる温度に安定的に制御でき、かつ、排気行程におけるポンピングロスの増加を回避できるという効果がある。

【0033】請求項8記載の発明によると、可変ノズル式の排気ターボチャージャを備えた圧縮着火機関であれば、部品コストを増加させることなく、筒内圧を低下させるときに、残留ガス量を増やして圧縮開始時の筒内温度を上昇させることができるという効果がある。

【0034】請求項9記載の発明によると、簡易な構造の吸気絞り弁を用いることで、コストの増大を抑えながら圧縮開始時の筒内圧を低下させ、所定運転領域での振動・騒音を低減させることができるという効果がある。

【0035】請求項10記載の発明によると、吸気弁の開時期を変化させることで、筒内圧を応答良く制御することができ、また、吸気行程でのポンピングロスの増加を回避できるという効果がある。

【0036】請求項11記載の発明によると、排気弁等の耐熱限度を超える温度にまで排気温度が上昇することを確実に回避でき、かつ、良好な燃焼が得られる温度を確実に維持できるという効果がある。

【0037】

【発明の実施の形態】以下に本発明の実施の形態を図に基づいて説明する。図1は、第1の実施形態を示す圧縮着火機関（ディーゼルエンジン）のシステム構成図である。

【0038】この図1に示す圧縮着火機関1の筒内には、吸気管2及び吸気弁（図示省略）を介して空気が吸引され、圧縮着火機関1からの燃焼排気は、排気弁（図示省略）及び排気管3を介して排出される。

【0039】前記吸気管2の途中には、図示省略したアクチュエータ（モータ等）で開閉駆動される吸気絞り弁4が介装され、また、前記排気管3の途中には、図示省略したアクチュエータ（モータ等）で開閉駆動される排気絞り弁5が介装される。

【0040】マイクロコンピュータを内蔵したコントロ

ールユニット6は、各種センサからの検出信号に基づき、前記吸気絞り弁4及び排気絞り弁5の開度を制御する。前記各種センサとしては、エンジン回転数 N_e (rpm)を検出する回転数センサ7、前記排気絞り弁5上流の排気管3内の排気温度 T_{ex} を検出する排気温度センサ8、車両の運転者によって操作されるアクセルペダルの開度（アクセル開度） V_a を検出するアクセル開度センサ9等が設けられている。

【0041】ここで、図2のフローチャートに従って、前記コントロールユニット6による吸気絞り弁4及び排気絞り弁5の開度制御を詳細に説明する。図2のフローチャートにおいて、STEP1では、回転数センサ7で検出されたエンジン回転数 N_e (rpm)を読み込み、STEP2では、アクセル開度センサ9で検出されたアクセル開度 V_a を読み込む。尚、前記アクセル開度 V_a は、本実施形態において、機関負荷を代表するパラメータである。

【0042】STEP3では、図3に示すように、予めエンジン回転数 N_e とアクセル開度 V_a とで運転領域を区分する運転領域マップ上に設定されたアイドルングを含む低回転低負荷領域に、前記STEP1, 2で読み込んだエンジン回転数 N_e (rpm)及びアクセル開度 V_a が含まれるか否かを判別することで、前記低回転低負荷領域に該当するか否かを判別する。

【0043】低回転低負荷領域に該当しない場合には、STEP4へ進んで、吸気絞り弁4を全開に制御し、また、次のSTEP5では、排気絞り弁5を全開に制御する。一方、低回転低負荷領域に該当する場合には、STEP6へ進み、図4に示すマップから排気絞り弁5の目標開度（操作量）を検索する。

【0044】前記4に示す排気絞り弁5の目標開度マップは、エンジン回転数 N_e (rpm)とアクセル開度 V_a とに応じて排気絞り弁5の目標開度が予め設定されたマップであり、前記低回転低負荷領域内で、エンジン回転数 N_e (rpm)が低いほど、また、アクセル開度 V_a が小さいほど（機関負荷が低いほど）、排気絞り弁5の目標開度としてより小さい開度が設定される特性になっている。

【0045】STEP7では、前記STEP6で設定された目標開度に、排気絞り弁5の開度を制御する。また、STEP8では、図5に示すマップから吸気絞り弁4の目標開度（操作量）を検索する。

【0046】前記図5に示す吸気絞り弁4の目標開度マップは、排気絞り弁5の目標開度マップと同様に、エンジン回転数 N_e (rpm)とアクセル開度 V_a とに応じて吸気絞り弁4の目標開度が予め設定されたマップであり、前記低回転低負荷領域内で、エンジン回転数 N_e (rpm)が低いほど、また、アクセル開度 V_a が小さいほど（機関負荷が低いほど）、吸気絞り弁4の目標開度としてより小さい開度が設定される特性になっている。

【0047】STEP 9では、前記STEP 8で設定された目標開度に、吸気絞り弁4の開度を制御する。STEP 10では、排気温度センサ8で検出された排気温度 T_{ex} を読み込む。

【0048】STEP 11では、エンジン回転数 N_e (rpm) とアクセル開度 V_a とに応じて排気温度 T_{ex} の限界最高温度 T_{max} を記憶したマップを参照し、そのときのエンジン回転数 N_e (rpm) 及びアクセル開度 V_a に対応する限界最高温度 T_{max} を検索する。

【0049】但し、本実施形態では、排気弁等の排気系10 部品の耐熱性等を考慮して、運転領域に関わらずに略一定の値がマップ値として記憶されている。従って、前記限界最高温度 T_{max} を固定値として与える構成としても良い。

【0050】STEP 12では、現在の排気温度 T_{ex} が前記限界最高温度 T_{max} を超えているか否かを判別する。現在の排気温度 T_{ex} が前記限界最高温度 T_{max} を超えている場合には、STEP 13へ進み、吸気絞り弁4の開度をSTEP 9における制御開度よりも更に絞る制御を行う。

【0051】STEP 12で、現在の排気温度 T_{ex} が前記限界最高温度 T_{max} 以下であると判別されたときには、ステップS14へ進む。STEP 14では、エンジン回転数 N_e (rpm) とアクセル開度 V_a とに応じて排気温度 T_{ex} の限界最低温度 T_{min} を記憶したマップを参照し、そのときのエンジン回転数 N_e (rpm) 及びアクセル開度 V_a に対応する限界最低温度 T_{min} を検索する。前記限界最低温度 T_{min} は、燃料の着火に必要な最低温度を示すものであり、図6に示すように、低回転低負荷側ほどより高い温度が要求される。

【0052】STEP 15では、現在の排気温度 T_{ex} が前記限界最低温度 T_{min} を下回っているか否かを判別する。現在の排気温度 T_{ex} が前記限界最低温度 T_{min} 以上であれば、図2のフローチャートに示されるルーチンを終了させることで、前記STEP 9で制御された吸気絞り弁4の開度をそのままとする。

【0053】一方、現在の排気温度 T_{ex} が前記限界最低温度 T_{min} を下回っている場合には、STEP 16へ進み、STEP 9における制御開度に対して吸気絞り弁4をより開ける制御を行う。

【0054】前記STEP 13, 16の制御においては、STEP 9での制御開度から一定値だけ開度を変化させるか、限界温度とそのときの排気温度 T_{ex} との偏差に応じて補正開度を決定し、STEP 9での制御開度を前記補正開度で補正するか、又は、予め定められた固定開度に吸気絞り弁4の開度を制御するか、そのときの限界温度に応じて予め設定される開度に吸気絞り弁4の開度を制御する。

【0055】以上のようにして、吸気絞り弁4及び排気絞り弁5の開度を制御することで、前記STEP 3で判50

別される低回転低負荷領域での振動・騒音を低減することができる。

【0056】即ち、吸気絞り弁4を低回転低負荷領域で絞ると、吸気絞り弁4下流側の吸気管2内の圧力は、大気圧よりも低くなり、吸気行程終了時と同じ筒内圧になる圧縮開始時の筒内圧は、吸気絞りを行わない場合よりも低くなり、結果、圧縮上死点付近での筒内圧が低下して、低回転低負荷領域での振動・騒音が低減される。従って、本実施形態において、前記吸気絞り弁4及びコントロールユニット6による吸気絞り制御機能によって、筒内圧低下手段が構成される。

【0057】但し、上記の吸気絞りによって、筒内圧が低下すると共に、圧縮上死点付近での筒内温度が低下してしまい、そのままでは着火安定性が損なわれて、失火の発生やエミッションの悪化を招く可能性がある。そこで、本実施形態では、吸気絞りと同時に、排気絞り弁5による排気絞りを行わせ、この排気絞りによって、圧縮開始時の筒内温度を高めて、着火安定性を維持できるようにしてある。

20 【0058】排気絞り弁5を絞ると、排気の抵抗が大きくなって、排気行程で筒内から排出されるガス量が少なくなり、相対的に筒内の残留ガス量が増えて、排気弁が閉じる時点での筒内の状態は排気絞りを行わない場合に比べて高温高圧になり、吸気弁が開く時点においても、排気絞りを行わない場合に比べて筒内は高温高圧になっている。吸気弁が開くと、吸気管2内の圧力よりも筒内の圧力が高いため、筒内の残留ガスが吸気管2に逆流し、吸気管2内では残留ガスと吸気との混合が進むが、物質の拡散や温度の伝播よりも圧力の伝播の方が非常に速いため、続く吸気行程での筒内の状態は、温度と組成が略残留ガスに等しく、圧力は、略吸気管2内の圧力に略等しい状態になる。

30 【0059】これにより、吸気行程終了時の筒内温度は排気絞りを行わない場合に比べて高くなり、圧縮開始時の筒内温度は、吸気行程終了時の筒内温度に等しいので、排気絞りを行うことで圧縮開始時の筒内温度が高くなり、たとえ吸気絞りが行われていても圧縮開始時の筒内温度を良好な燃焼が行える筒内温度に維持することができる。

40 【0060】従って、低回転低負荷領域で、筒圧の低下によって振動・騒音を低減しつつ、着火安定性を確保して、失火やエミッションの悪化を回避できることになり、また、低回転低負荷領域以外では、吸気絞り弁4及び排気絞り弁5が全開に保持されるので、運転性能を低下させることがない。

【0061】尚、排気絞りによって圧縮開始時の筒内温度を高くするので、前記排気絞り弁5及びコントロールユニット6による排気絞り制御機能によって、筒内温度上昇手段が構成される。

【0062】ところで、上記の制御では、筒内温度が所

期温度に制御されるものとして、吸気絞り弁4及び排気絞り弁5が制御されるが、運転状態の変化に対して筒内温度の制御が遅れるなどして、良好な燃焼が行える筒内温度を下回ったり、逆に、排気弁などの排気系部品の耐熱温度を超えて温度上昇してしまう可能性がある。そこで、本実施形態では、STEP12～16において、排気温度 T_{ex} の判別結果から振動・騒音の低減制御に優先して吸気絞り弁4の開度を制御するようにしてある。

【0063】即ち、限界最高温度 T_{max} を超える状態では、より吸気絞り弁4を閉じて筒内圧を低下させることで、排気温度の早期低下を図り、限界最低温度 T_{min} を下回る状態では、より吸気絞り弁4を開いて筒内圧を上昇させることで、排気温度の早期上昇を図るようにしてある。

【0064】このようにして、排気温度 T_{ex} が限界最低温度 T_{min} を下回ることがないように、振動・騒音の低減に優先して吸気絞り弁4を制御すれば、圧縮開始時の筒内温度を良好な燃焼が得られる温度に確実に維持でき、また、排気温度 T_{ex} が限界最高温度 T_{max} を上回ることがないように吸気絞り弁4を制御すれば、排気弁などの排気系部品の耐熱温度を超えて温度上昇することを確実に回避できる。

【0065】尚、STEP12～STEP16に示される排気温度 T_{ex} と限界最低温度 T_{min} 、限界最高温度 T_{max} との比較に基づく吸気絞り弁4の制御が、補正制御手段に相当する。

【0066】更に、上記実施形態では、筒内温度を上昇させるために残留ガス量を増大させるが、残留ガス量が増大することで燃焼温度が低下し、 NO_x を低減できるという効果も生じる。

【0067】図7は、第2の実施形態を示す圧縮着火機関のシステム構成図であり、前記図1に示した圧縮着火機関1に対して、吸気絞り弁4を備えずに、吸気弁（図示省略）の閉時期を変更できる可変動弁機構10を備える点のみが異なる。

【0068】前記可変動弁機構10としては、複数のカムを切り換える機構、カムシャフトの位相を変化させる機構などの公知の機構を適用できるが、特に、閉弁用電磁石と開弁用電磁石とで吸気弁を開閉駆動する構成の電磁駆動弁装置が、吸気弁の開閉時期を連続的に広い範囲で任意に変更できることから最も好ましく、本実施形態では、前記電磁駆動弁装置を可変動弁機構10として用いるものとする。

【0069】第2の実施形態は、前記第1の実施形態における吸気絞り弁4の絞り制御に代えて、前記可変動弁機構10により吸気弁の閉時期を変更することで、低回転低負荷領域で圧縮開始時の筒内圧を低下させる構成であり、係る制御の詳細を図8のフローチャートに従って説明する。

【0070】尚、図2のフローチャートにおいて吸気絞

り弁4に関する処理を行うステップ（STEP4, 8, 9, 13, 16）が、図8のフローチャートでは吸気弁の閉時期の制御に変更されるが、その他のステップでの処理内容は、図2のフローチャートと同様である。

【0071】図8のフローチャートにおいて、STEP1, 2で読み込んだエンジン回転数 N_e (rpm) 及びアクセル開度 V_a に基づき、STEP3で低回転低負荷領域（図3参照）でないと判別されると、STEP4で、吸気弁の閉時期を制御範囲内の最も遅い時期である通常時期に設定し、STEP5では排気絞り弁5を全開に制御する。

【0072】一方、低回転低負荷領域である場合には、STEP6, 7で、排気絞り弁5を、エンジン回転数 N_e (rpm) 及びアクセル開度 V_a に応じた開度（図4参照）に制御した後、STEP8へ進む。

【0073】STEP8では、エンジン回転数 N_e (rpm) 及びアクセル開度 V_a に応じて予め吸気弁の閉時期を記憶したマップを参照し、吸気弁の閉時期を求める。そして、STEP9では、STEP8で設定された閉時期で吸気弁を閉じる設定を行う。

【0074】前記吸気弁の閉時期を記憶したマップは、図9に示すように、STEP3で判別される低回転低負荷領域内で、回転が低いほど、負荷が小さいほど、吸気弁の閉時期としてより早い時期が設定され、吸気弁の閉時期が、図10に示すように下死点（BDC）を超えて早められるようになっている。

【0075】上記のように、吸気弁の閉時期を下死点（BDC）前に早めると、ピストンの下降（吸気行程）途中で吸気弁が閉じて筒内が密閉されるため、その後は断熱膨張して温度を下げながら下死点に至り、圧縮行程に転じると、吸気弁が閉じられたピストン位置付近から圧縮が始まるので、実質的な圧縮比が小さくなり筒内圧が低下する。従って、第2の実施形態において、筒内圧低下手段は、可変動弁機構10とコントロールユニット6による吸気弁の閉時期の制御機能とで構成される。

【0076】このように、第2の実施形態では、吸気弁の閉時期を早めることで、圧縮開始時の筒内圧を低下させ、低回転低負荷領域での振動・騒音を低減させるものであり、筒内圧の低下による筒内温度の低下は、第1の実施形態と同様に、排気絞りを行うことで補われ、良好な燃焼が行える筒内温度に維持される。

【0077】また、第2の実施形態では、吸気絞りを行わないので、吸気行程の圧力が略大気圧となり、第1の実施形態に比べて吸気行程のポンピングロスが少なくなる。第2の実施形態においても、排気温度 T_{ex} と限界最高温度 T_{max} 、限界最低温度 T_{min} との比較に基づく制御を行うが、吸気弁の閉時期を早めることで圧縮開始時の筒内圧を低下させるので、前記限界温度 T_{max} 、 T_{min} に基づく制御も、吸気弁の閉時期について行われる。

【0078】即ち、排気温度 T_{ex} が限界最高温度 T_{max}

を超えているか否かをSTEP 12で判別し、排気温度Texが限界最高温度Tmaxを超えている場合には、排気温度Texを低下させるべく、STEP 13で吸気弁の閉時期をより早めて筒内圧を更に低下させる処理を行う。

【0079】また、排気温度Texが限界最高温度Tmax以下であれば、排気温度Texが限界最低温度Tminを下回っているか否かをSTEP 15で判別し、排気温度Texが限界最低温度Tminを下回る場合には、STEP 16で吸気弁の閉時期を遅くすることで筒内圧を高めて、良好な燃焼が行える筒内温度を確保できるようにする。

【0080】前記STEP 13, 16における吸気弁の閉時期の制御は、第1の実施形態における吸気絞り弁4の制御と同様に、閉時期を一定値だけ補正するか、限界温度Tmax, Tminとそのときの排気温度Texとの偏差に応じた補正值で閉時期を補正するか、又は、予め定められた固定時期に吸気弁の閉時期を変更するか、そのときの限界温度Tmax, Tminに応じた閉時期に吸気弁の閉時期を変更することで行われる。

【0081】第2の実施形態では、STEP 12～STEP 16に示される排気温度Texと限界最低温度Tmin, 限界最高温度Tmaxとの比較に基づく吸気弁の閉時期の制御が、補正制御手段に相当する。

【0082】尚、上記第2の実施形態では、吸気弁の閉時期を早めることで圧縮比を小さくして筒内圧を低下させる構成としたが、逆に、吸気弁の閉時期を下死点(BDC)以降に遅くすることで、圧縮比を小さくして筒内圧を低下させることが可能である。吸気弁の閉時期を下死点(BDC)以降に遅くすると、一旦筒内に吸引された空気がピストンの上昇による筒内圧の上昇に伴って吸気管2側に吐き戻され、吸気弁が閉じられてから圧縮が始まるので、実質的な圧縮比が小さくなり筒内圧が低下することになる。

【0083】図11は、第3の実施形態を示す圧縮着火機関のシステム構成図であり、前記図1に示した圧縮着火機関1に対して、排気絞り弁5を備えずに、排気弁(図示省略)の閉時期を変更できる可変動弁機構11を備える点のみが異なる。

【0084】前記可変動弁機構11としては、吸気弁の開閉時期を変更する可変動弁機構10と同様に、閉弁用電磁石と開弁用電磁石とで排気弁を開閉駆動する構成の電磁駆動弁装置を用いるものとする。

【0085】第3の実施形態では、第1の実施形態における排気絞り弁5の絞り制御に代えて、前記可変動弁機構11により排気弁の閉時期を変更することで、圧縮開始時の筒内温度を低回転低負荷領域で上昇させる構成であり、係る制御の詳細を図12のフローチャートに従って説明する。

【0086】尚、図12のフローチャートは、図2のフローチャートの排気絞り弁5に関する処理を行うステップ(STEP 5, 6, 7)が、排気弁の閉時期の制御に

変更される点のみが異なる。

【0087】図12のフローチャートにおいて、STEP 1, 2で読み込んだエンジン回転数Ne (rpm) 及びアクセル開度Vaに基づき、STEP 3で低回転低負荷領域でないと判別されると、STEP 4で、吸気絞り弁を全開に制御し、STEP 5では、排気弁の閉時期を、制御範囲内で最も遅い通常時期に設定する。

【0088】一方、低回転低負荷領域(図3参照)である場合には、STEP 6で、エンジン回転数Ne (rpm) 及びアクセル開度Vaに応じて予め排気弁の閉時期を記憶したマップを参照し、排気弁の閉時期を求める。前記排気弁の閉時期を記憶したマップは、図13に示すように、低回転低負荷領域内で回転が低いほどまた負荷が小さいほど、排気弁の閉時期としてより早い時期が設定され、閉時期が早められることで、図14に示すように閉時期がTDC前に設定されるようにしてある。

【0089】そして、STEP 7では、STEP 6で設定された閉時期で排気弁を閉じる設定を行う。上記のように、排気弁の閉時期を早めると、排気行程で筒内から排出されるガス量が少なくなって相対的に残留ガス量が増し、排気絞りを行うときと同様にして圧縮開始時の筒内温度が上昇する。

【0090】尚、第3の実施形態において、前記可変動弁機構11及びコントロールユニット6による排気弁の閉時期の制御機能が、筒内温度上昇手段に相当することになる。

【0091】従って、第3の実施形態では、吸気絞り弁を絞ることで圧縮開始時の筒内圧を低下させ、これによって低回転低負荷領域での振動・騒音を低減させつつ、筒内圧の低下による筒内温度の低下は、排気弁の閉時期を早めて残留ガス量を増大させることで補い、良好な燃焼が行える筒内温度に維持する。

【0092】第1, 第2の実施形態のように、排気絞りを行って残留ガス量を増大させる構成の場合、排気絞り弁上流側の排気容積によって残留ガス量の調整に遅れが生じるが、上記のように、排気弁の閉時期で残留ガス量を調整する構成であれば、応答良く残留ガス量を調整することができ、運転条件の変化に対して過渡的な遅れを生じることなく燃焼に必要な筒内温度を維持できる。

【0093】図15は、第4の実施形態を示す圧縮着火機関のシステム構成図であり、前記図1に示した圧縮着火機関1に対して、吸気絞り弁4及び排気絞り弁5を備えずに、吸気弁(図示省略)の閉時期を変更できる可変動弁機構10、及び、排気弁(図示省略)の閉時期を変更できる可変動弁機構11を備える点異なる。

【0094】即ち、第4の実施形態では、前記吸気絞り弁4の絞り制御に代えて、前記可変動弁機構10により吸気弁の閉時期を変更することで、圧縮開始時の筒内圧を低回転低負荷領域で低下させ(第2の実施形態と同様)、かつ、前記排気絞り弁5の絞り制御に代えて、前

記可変動弁機構11により排気弁の開時期を変更することで、圧縮開始時の筒内温度を低回転低負荷領域で上昇させる構成である(第3の実施形態と同様)。

【0095】この第4の実施形態における制御の詳細は、図16のフローチャートに示されるが、吸気弁の開時期の制御に関わるステップ(STEP4, 8, 9, 13, 16)は、第2の実施形態で説明したものと同様であり、また、排気弁の開時期の制御に関わるステップ(STEP5, 6, 7)は、第3の実施形態で説明したものと同様であり、ここでの詳細な説明は省略する。

【0096】上記第4の実施形態では、低回転低負荷領域で、図17に示すように、吸気弁の開時期を早める(又は遅らせる)ことで筒内圧を低下させ、同時に、排気弁の開時期を早めることで残留ガスを増加させて筒内温度の上昇を図り、低回転低負荷領域での振動・騒音を低減させつつ、良好な燃焼が行える筒内温度に維持する。

【0097】上記構成では、吸気行程でのポンピングロスを増加させることなく筒内圧を低下させることができ、また、筒内温度を上昇させるための残留ガスの増大制御を遅れなく行え、良好な燃焼が行える筒内温度に安定的に維持できる。

【0098】図18は、第5の実施形態を示す圧縮着火機関のシステム構成図であり、吸気弁(図示省略)の開時期を変更できる可変動弁機構12、及び、排気弁(図示省略)の開時期を変更できる可変動弁機構11を備えると共に、吸気絞り弁4を備える構成である。

【0099】尚、吸気弁(図示省略)の開時期を変更できる可変動弁機構12としても、電磁駆動弁装置を用いるものとする。そして、第5の実施形態では、吸気絞り弁4による吸気絞りによって筒内圧を低下させる一方、排気弁の開時期及び吸気弁の開時期の遅延制御によって筒内温度を上昇させる構成となっている。

【0100】図19のフローチャートは、上記第5の実施形態における制御の詳細を示すものであり、STEP1, 2で読み込んだエンジン回転数 N_e (rpm)及びアクセル開度 V_a に基づき、STEP3で低回転低負荷領域でないと判別されると、STEP4で、吸気絞り弁4を全開に制御し、次のSTEP5では、吸気弁の開時期及び排気弁の開時期を最も早い時期(通常時期)に設定する。

【0101】一方、低回転低負荷領域である場合には、STEP6へ進み、エンジン回転数 N_e (rpm)及びアクセル開度 V_a に応じて予め排気弁の開時期及び吸気弁の開時期を記憶したマップを参照し、排気弁の開時期及び吸気弁の開時期を求める。

【0102】そして、STEP7では、STEP6で設定された閉時期で排気弁を閉じ、STEP6で設定された開時期で吸気弁を開く設定を行う。前記排気弁の開時期及び吸気弁の開時期を記憶したマップは、図20に示

すように、低回転低負荷領域で回転が低いほどまた負荷が小さいほど、排気弁の開時期及び吸気弁の開時期を遅らせるようになっており、詳しくは、排気弁の開時期を上死点(TDC)以降に遅らせ、かつ、吸気弁の開期間が排気弁の開期間とオーバーラップすることがないように、排気弁の開時期以降に吸気弁の開時期を遅らせるようにしてある(図21参照)。

【0103】排気弁の開時期を上死点(TDC)以降に遅らせると、筒内から一旦排出されたガスが筒内に戻されて、残留ガス量が増大することになり、この残留ガス量の増大により圧縮開始時の筒内温度を上昇させるが、オーバーラップ期間があると、掃気されて残留ガスを増大させることができなくなるので、排気弁の開時期を遅らせるのに合わせて吸気弁の開時期を遅らせ、オーバーラップ期間を無くするようにする。

【0104】この第5の実施形態では、排気絞りによって残留ガスを増大させる場合に比べて、排気行程でのポンピングロスを小さくできる。尚、第5の実施形態において、可変動弁機構11, 12及びコントロールユニット6による排気弁の開時期及び吸気弁の開時期を遅らせる制御機能が、筒内温度上昇手段に相当する。

【0105】図22は、第6の実施形態を示す圧縮着火機関のシステム構成図であり、吸気絞り弁4及び排気絞り弁5を備えずに、吸気弁(図示省略)の開時期及び閉時期を変更できる可変動弁機構13、及び、排気弁(図示省略)の開時期を変更できる可変動弁機構11を備える構成である。

【0106】尚、吸気弁の開時期及び閉時期を変更できる可変動弁機構13としても、電磁駆動弁装置を用いるものとする。そして、第6の実施形態では、前記第5の実施形態と同様にして、排気弁の開時期及び吸気弁の開時期を遅らせることで、残留ガスを増大させるよう構成されると共に、第2の実施形態と同様に、吸気弁の開時期を早める(又は遅くする)ことで圧縮開始時の筒内圧を低下させる構成である(図23参照)。

【0107】図24のフローチャートは、上記第6の実施形態における制御の詳細を示すものであり、STEP1, 2で読み込んだエンジン回転数 N_e (rpm)及びアクセル開度 V_a に基づき、STEP3で低回転低負荷領域でないと判別されると、STEP4で、吸気弁の開時期を最も遅くし、次のSTEP5では、吸気弁の開時期及び排気弁の開時期を最も早い時期に設定する。

【0108】一方、低回転低負荷領域である場合には、STEP6へ進み、エンジン回転数 N_e (rpm)及びアクセル開度 V_a に応じて予め排気弁の開時期及び吸気弁の開時期を記憶したマップ(図20)を参照し、排気弁の開時期及び吸気弁の開時期として低回転低負荷領域でないときよりも遅い時期を設定する。

【0109】そして、STEP7では、STEP6で設定された閉時期で排気弁を閉じ、STEP6で設定され

た開時期で吸気弁を開く設定を行う。ここでの排気弁の閉時期及び吸気弁の開時期を共に遅らせる処理により、残留ガス量が増え、筒内温度が上昇する。

【0110】STEP 8では、低回転低負荷時ほど吸気弁の開時期を早める設定を行い（図9参照）、STEP 9では前記設定に基づいて吸気弁の閉時期を制御し、吸気弁の閉時期を早めることで筒内圧を低下させる。

【0111】また、STEP 12～16では、限界最高温度 T_{max} を排気温度 T_{ex} が超えるときに、吸気弁の閉時期をより早めて筒内圧を更に低下させ、排気温度 T_{ex} 10 が限界最小温度 T_{min} を下回るときに、吸気弁の閉時期を遅くして筒内圧を上昇させて良好な燃焼を行わせることができる筒内温度にまで上昇させる。

【0112】図25は、第7の実施形態を示す圧縮着火機関のシステム構成図であり、吸気絞り弁4は備えるが、排気絞り弁5は備えず、また、可変ノズル式の排気ターボチャージャ15を備えている。

【0113】前記可変ノズル式の排気ターボチャージャ15は、例えば図26に示すように、排気タービンの回転翼20の回りに、開度を変化させることができるノズルベーン（可変翼）21を備えたもので、前記ノズルベーン（可変翼）22を閉じると、回転翼20に排気を導く流路の面積が絞られる構成である。 20

【0114】上記第7の実施形態では、筒内圧の低下は、第1の実施形態と同様に、吸気絞りによって行うが、残留ガス量の増大による筒内温度の上昇を、前記ノズルベーン（可変翼）21の制御による排気抵抗の調整によって行う構成となっている。

【0115】具体的には、図27のフローチャートに示すように、低回転低負荷領域でないときには、STEP 30 4で吸気絞り弁4を全開に制御し、また、STEP 5では、前記ノズルベーン21（VN）を全開に制御する。

【0116】一方、低回転低負荷領域では、STEP 6で、エンジン回転数 N_e （rpm）及びアクセル開度 V_a に応じて予めノズルベーン21（VN）を開度を記憶したマップを参照して、ノズルベーン21（VN）の目標開度を求め、STEP 7で、ノズルベーン21（VN）の開度を前記目標開度に制御する。

【0117】前記ノズルベーン21（VN）の開度マップは、図28に示すように、低回転低負荷側ほど、ノズルベーン21（VN）の開度を絞る構成になっており、ノズルベーン21（VN）の開度を絞ることで排圧が上昇し、残留ガス量が増加することで、圧縮開始時の筒内温度が上昇する。従って、第7の実施形態では、前記可変ノズル式の排気ターボチャージャ12とコントロールユニット6によるノズルベーン21（VN）の開度制御機能とで、筒内温度上昇手段が構成される。

【0118】一方、吸気絞り弁4は、低回転低負荷側ほど開度を絞るように制御され、低回転低負荷側ほど筒内圧を低下させる。上記第7の実施形態では、可変ノズル 50

式の排気ターボチャージャ12を備えた機関であれば、部品を追加することなく、筒内温度の上昇を図ることができるという利点がある。

【0119】尚、排気ターボチャージャ12による過給が吸気絞りの妨げになるが、アイドルリング等の低回転低負荷領域では、排気ターボチャージャ15の効率が悪く、実際には過給が行われないので、吸気絞りに影響を与えることはない。

【0120】図29は、第8の実施形態を示す圧縮着火機関のシステム構成図であり、吸気弁の開時期を変更できる可変動弁機構10と、可変ノズル式の排気ターボチャージャ15とを備えている。

【0121】この第8の実施形態では、図30のフローチャートに示されるように、第7の実施形態と同様に、可変ノズル式排気ターボチャージャ15のノズルベーン21（VN）の開度を制御することで、低回転低負荷領域での筒内温度の上昇を図る一方、第2の実施形態と同様に、吸気弁の開時期を早める（又は遅らせる）制御（図9参照）によって低回転低負荷領域での筒内圧の低下を図るものである。

【0122】この第8の実施形態では、第7の実施形態に対して、吸気絞りを行わないことから吸気行程におけるポンピングロス小さくできる。尚、以上の第1～8の実施形態において、補正制御手段は、筒内圧低下手段側で構成されているが、補正制御手段を筒内温度上昇手段側で構成しても良い。

【0123】即ち、排気絞り弁により補正制御手段を構成する場合、図2、図8のSTEP 13で排気絞り弁→開、STEP 16で排気絞り弁→閉とし、排気弁閉時期により補正制御手段を構成する場合、図12、図15のSTEP 13で排気弁閉→遅、STEP 16で排気弁閉→早とし、排気弁閉時期と吸気弁開時期により補正制御手段を構成する場合、図19、図24のSTEP 13で排気弁閉→早、吸気弁開→早、STEP 16で排気弁閉→遅、吸気弁開→遅とし、VN開度により補正制御手段を構成する場合、図27、図30のSTEP 13でVN→開、STEP 16でVN→閉とすれば良い。

【図面の簡単な説明】

【図1】第1の実施形態における圧縮着火機関を示すシステム構成図。

【図2】第1の実施形態における制御内容を示すフローチャート。

【図3】第1の実施形態における低回転低負荷領域マップを示す図。

【図4】第1の実施形態における排気絞り弁の開度マップを示す図。

【図5】第1の実施形態における吸気絞り弁の開度マップを示す図。

【図6】第1の実施形態における限界最低温度マップを示す図。

【図7】第2の実施形態における圧縮着火機関を示すシステム構成図。

【図8】第2の実施形態における制御内容を示すフローチャート。

【図9】第2の実施形態における吸気弁の閉時期マップを示す図。

【図10】第2の実施形態における吸気弁の閉時期の制御特性を示す図。

【図11】第3の実施形態における圧縮着火機関を示すシステム構成図。

【図12】第3の実施形態における制御内容を示すフローチャート。

【図13】第3の実施形態における排気弁の閉時期マップを示す図。

【図14】第3の実施形態における排気弁の閉時期の制御特性を示す図。

【図15】第4の実施形態における圧縮着火機関を示すシステム構成図。

【図16】第4の実施形態における制御内容を示すフローチャート。

【図17】第4の実施形態における排気弁の閉時期及び吸気弁の閉時期の制御特性を示す図。

【図18】第5の実施形態における圧縮着火機関を示すシステム構成図。

【図19】第5の実施形態における制御内容を示すフローチャート。

【図20】第5の実施形態における排気弁の閉時期及び吸気弁の開時期マップを示す図。

【図21】第5の実施形態における排気弁の閉時期及び吸気弁の開時期の制御特性を示す図。

【図22】第6の実施形態における圧縮着火機関を示す

システム構成図。

【図23】第6の実施形態における排気弁の閉時期及び吸気弁の開閉時期の制御特性を示す図。

【図24】第6の実施形態における制御内容を示すフローチャート。

【図25】第7の実施形態における圧縮着火機関を示すシステム構成図。

【図26】第7の実施形態における排気タービン及びノズルベーンを詳細に示す図。

【図27】第7の実施形態における制御内容を示すフローチャート。

【図28】第7の実施形態におけるノズルベーンの開度マップを示す図。

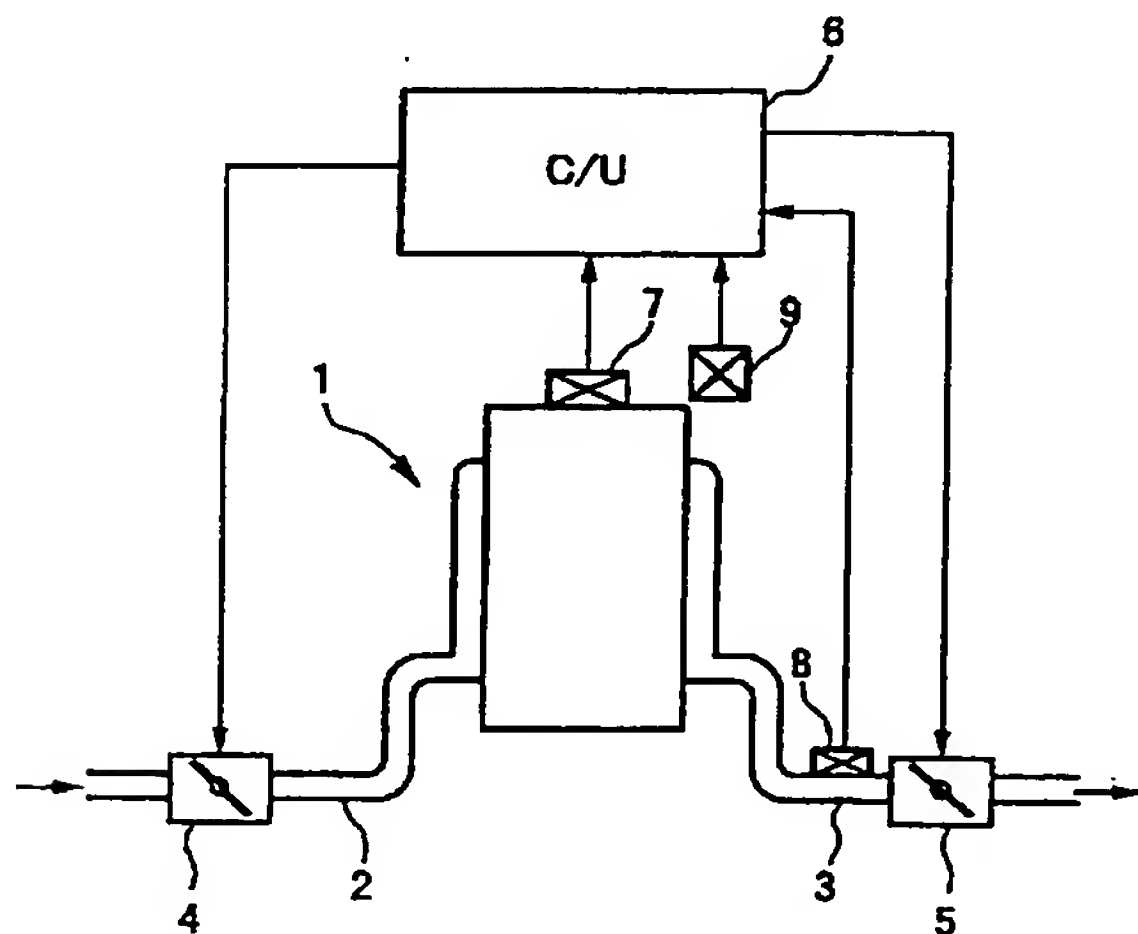
【図29】第8の実施形態における圧縮着火機関を示すシステム構成図。

【図30】第8の実施形態における制御内容を示すフローチャート。

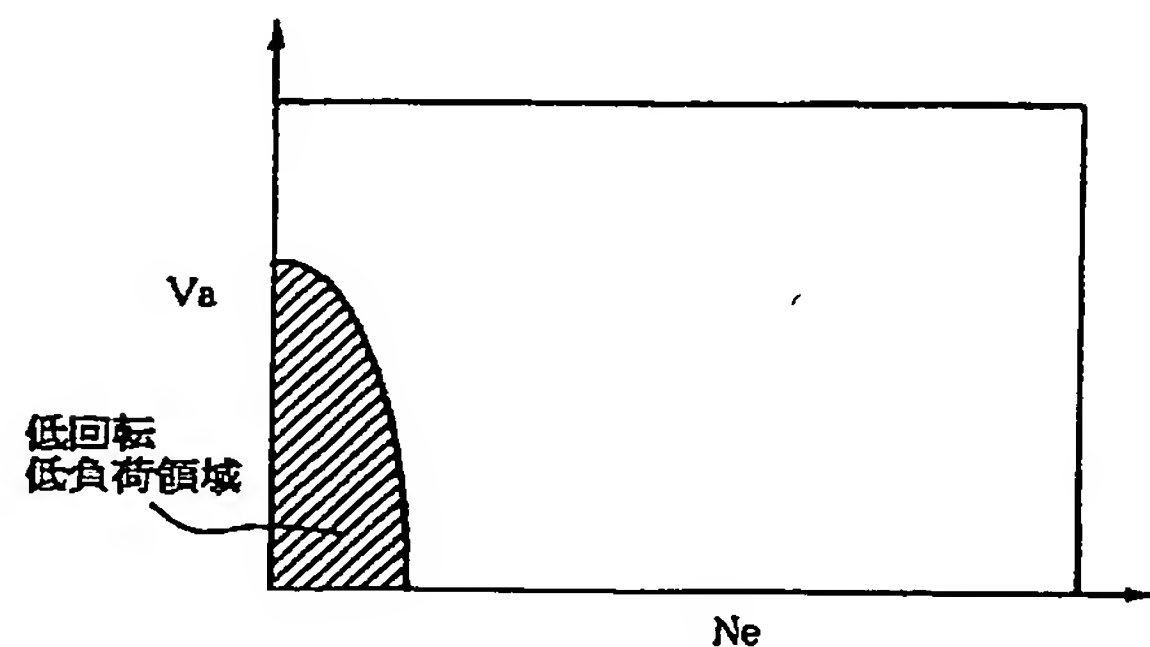
【符号の説明】

- 1…圧縮着火機関
- 2…吸気管
- 3…排気管
- 4…吸気絞り弁
- 5…排気絞り弁
- 6…コントロールユニット
- 7…回転数センサ
- 8…排気温度センサ
- 9…アクセル開度センサ
- 10～13…可変動弁機構
- 15…排気ターボチャージャ
- 21…ノズルベーン

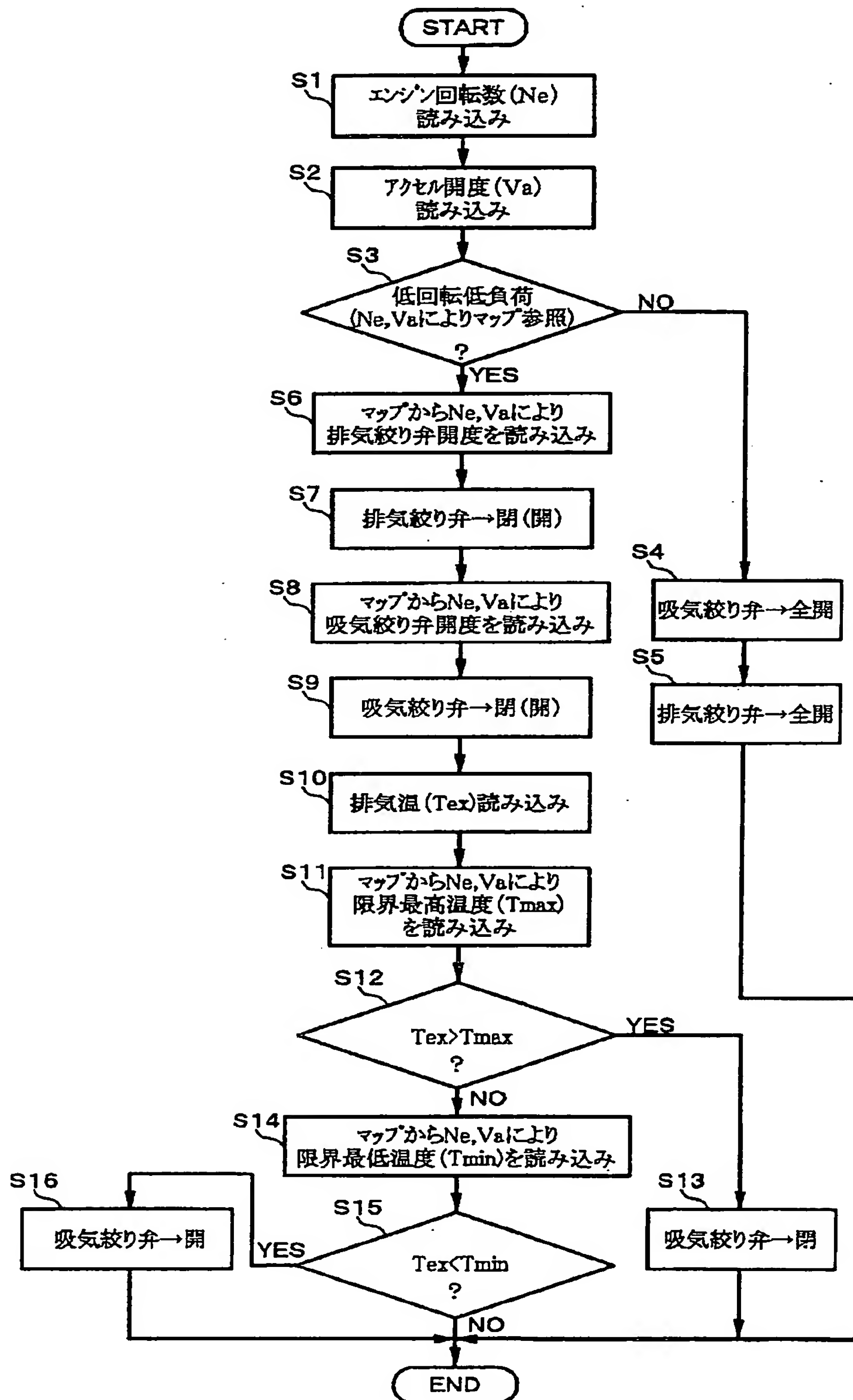
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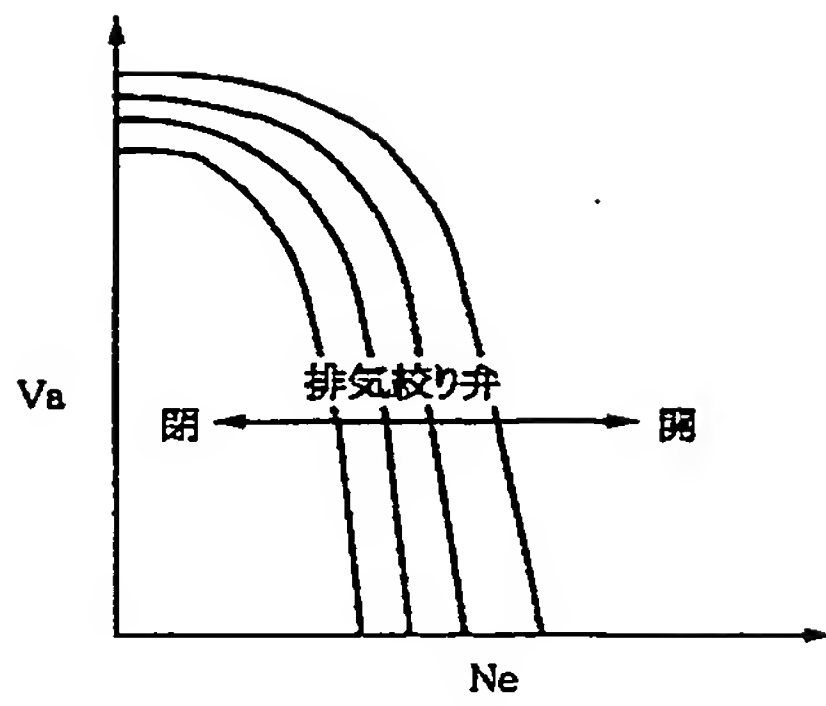
【図3】



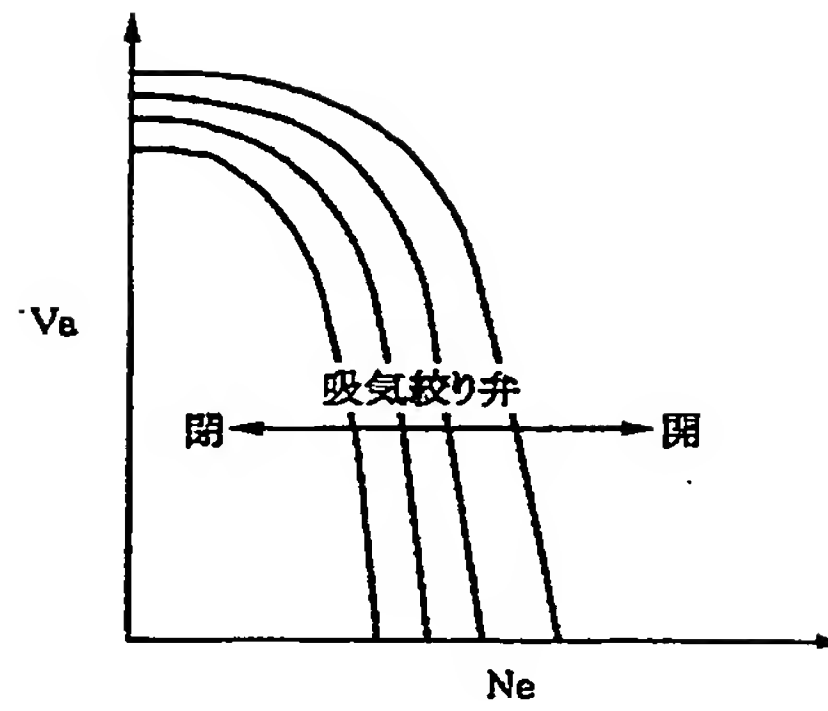
【図2】



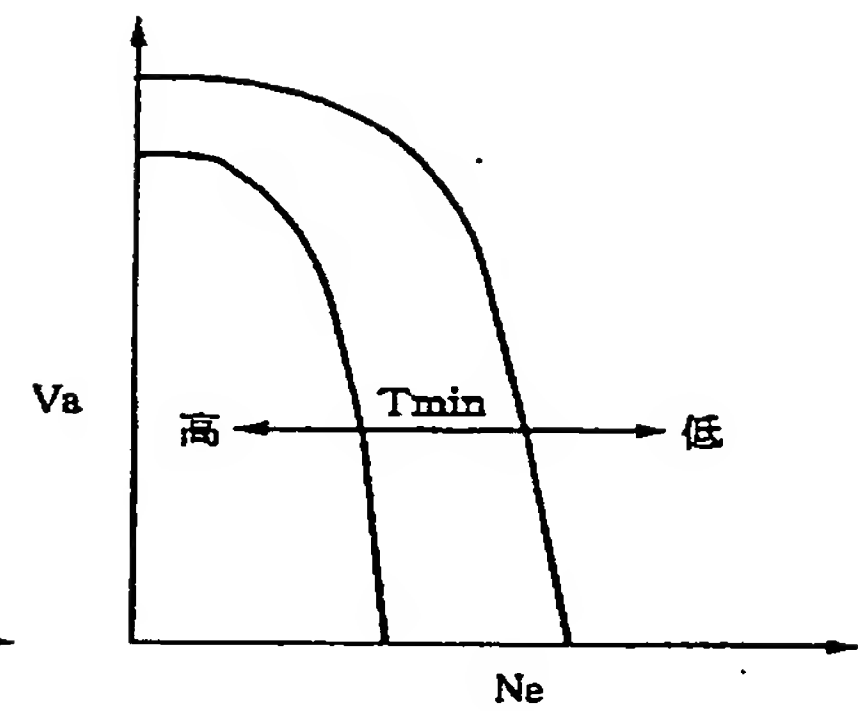
【図4】



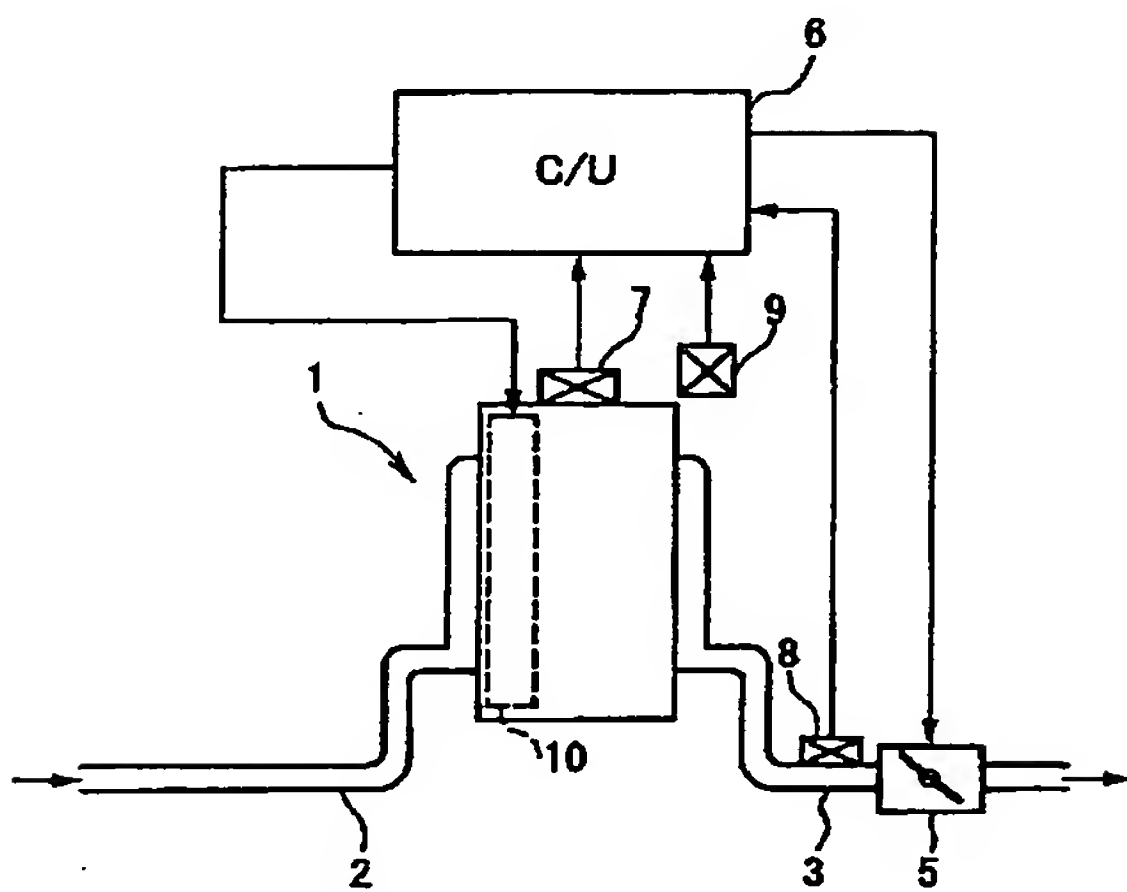
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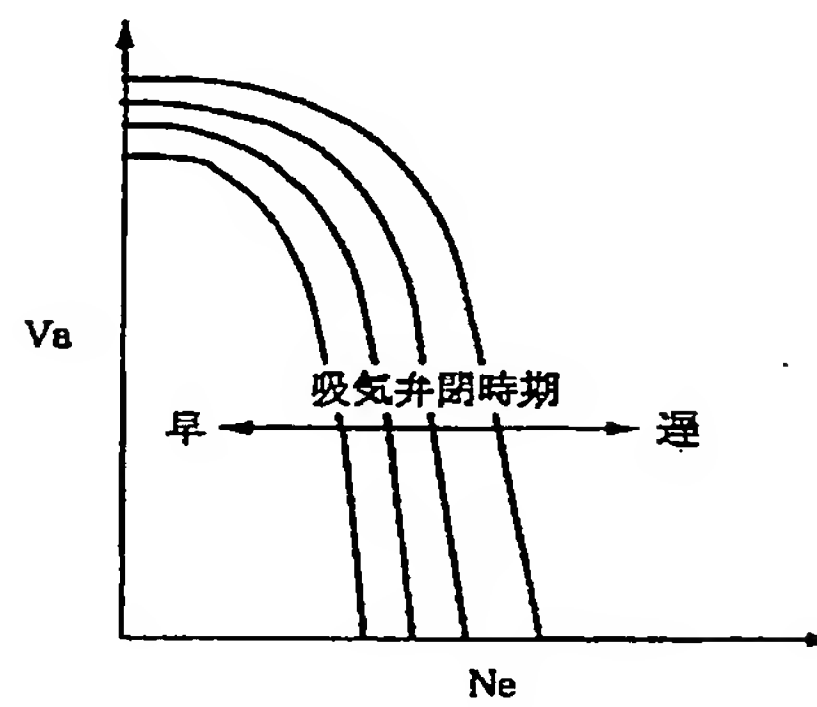
【図6】



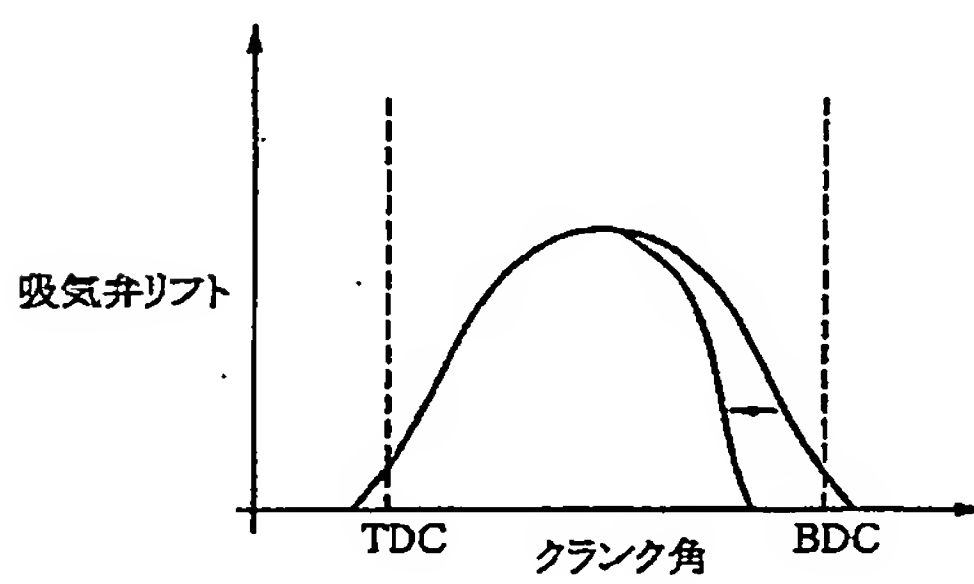
【図7】



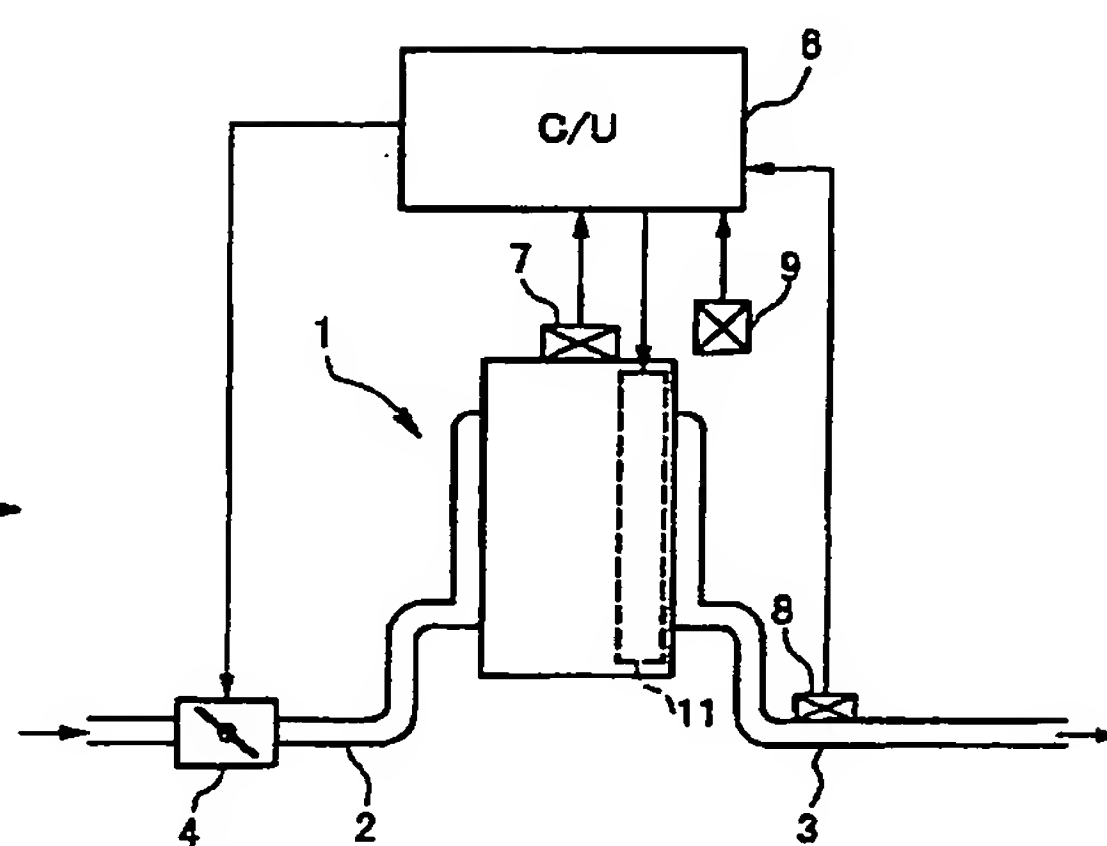
【図9】



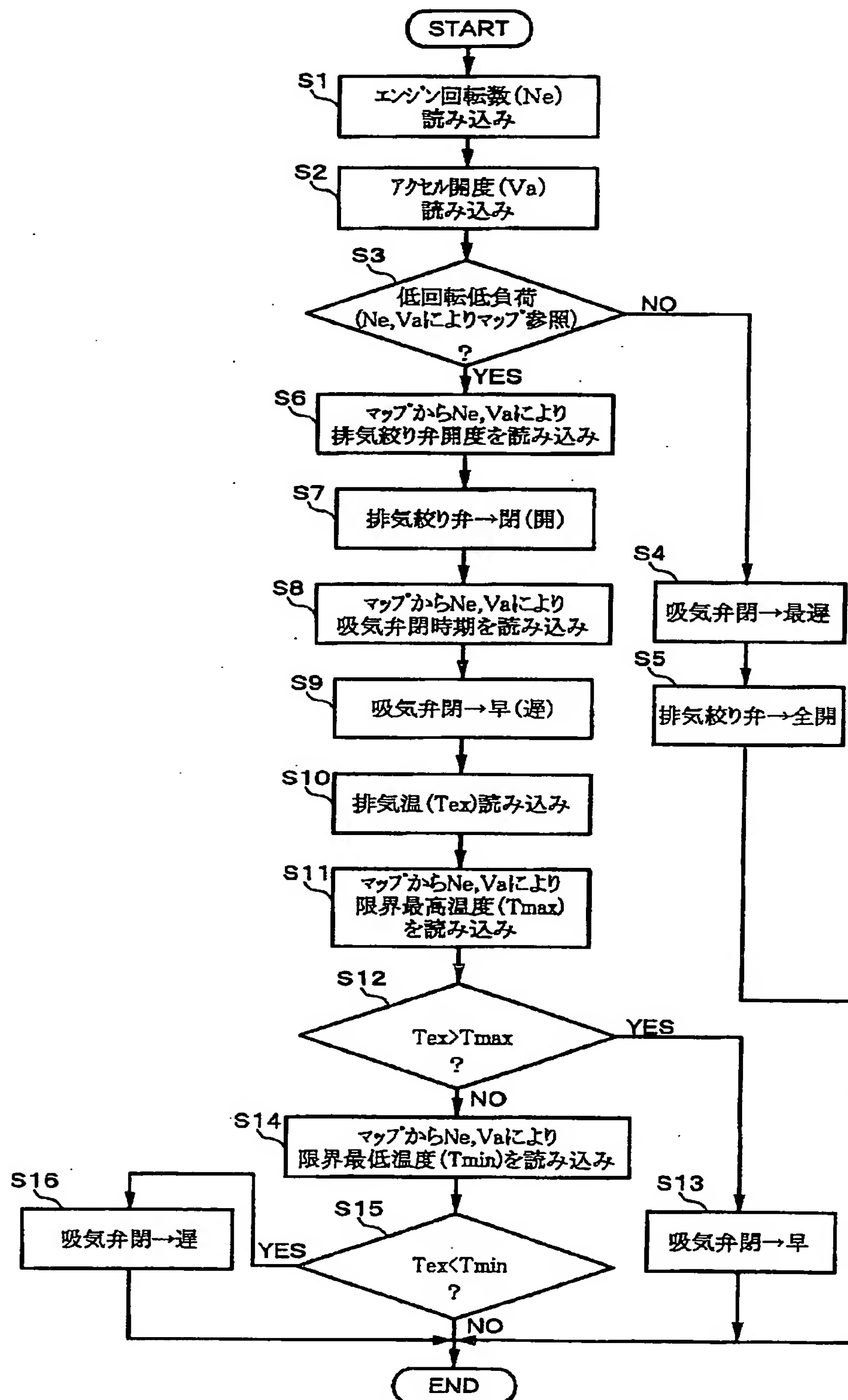
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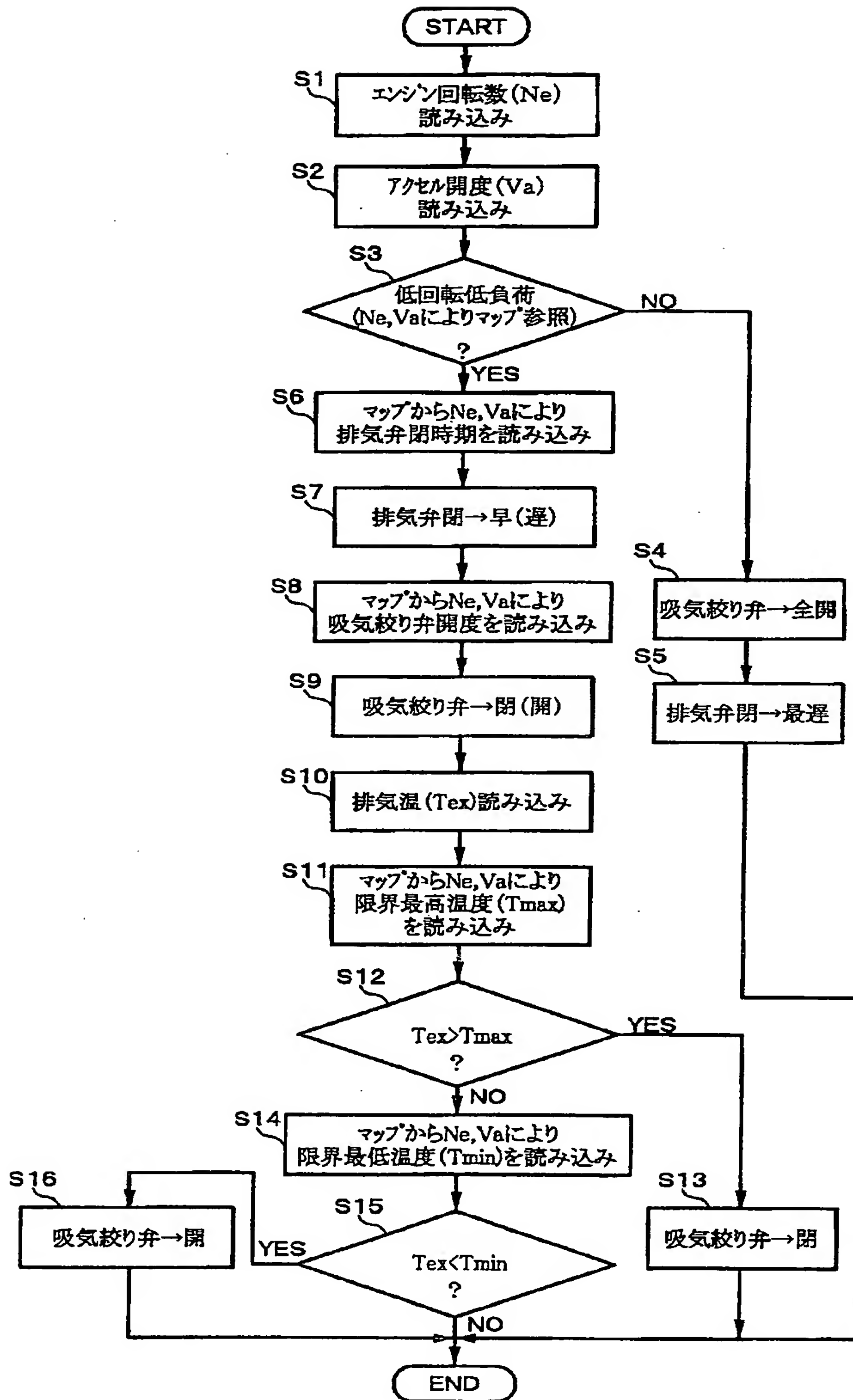
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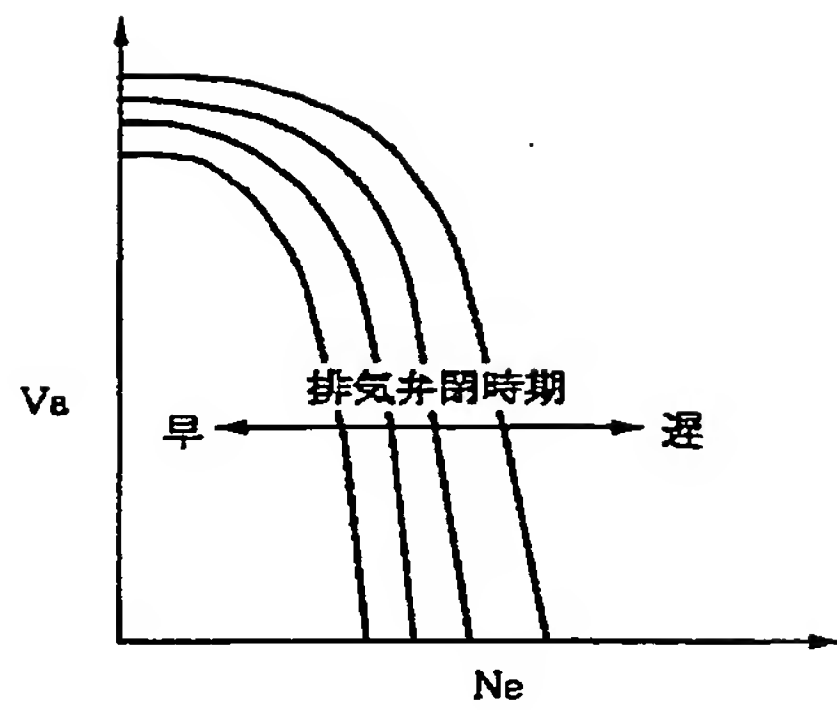
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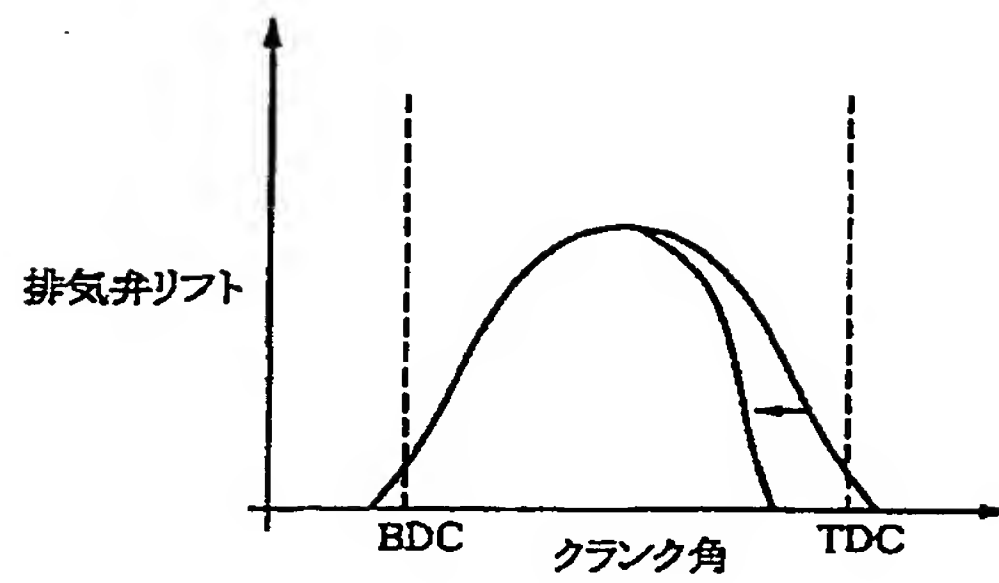
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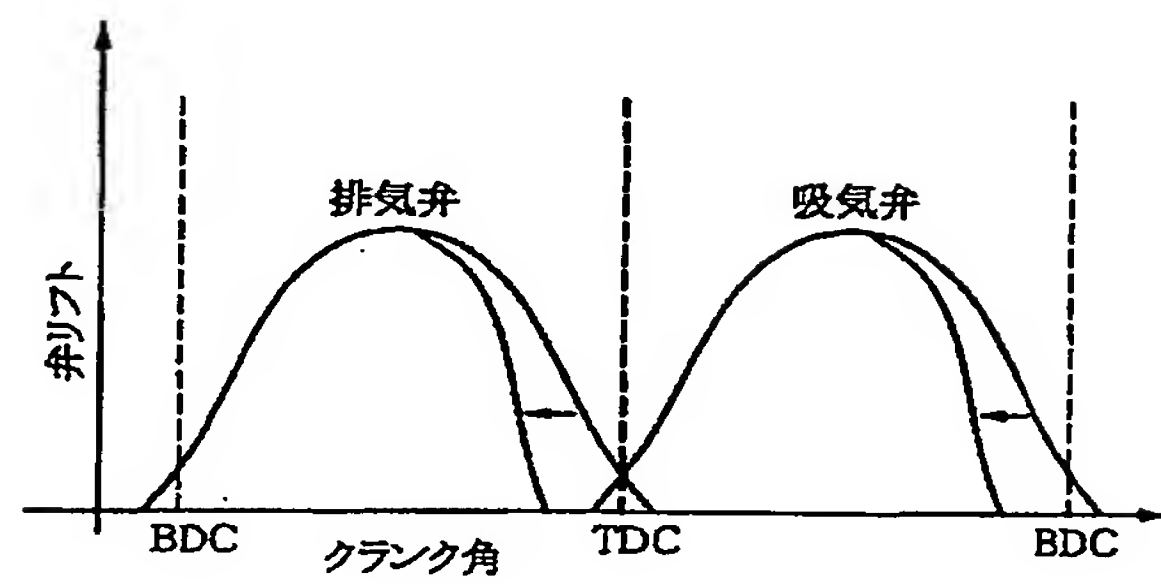
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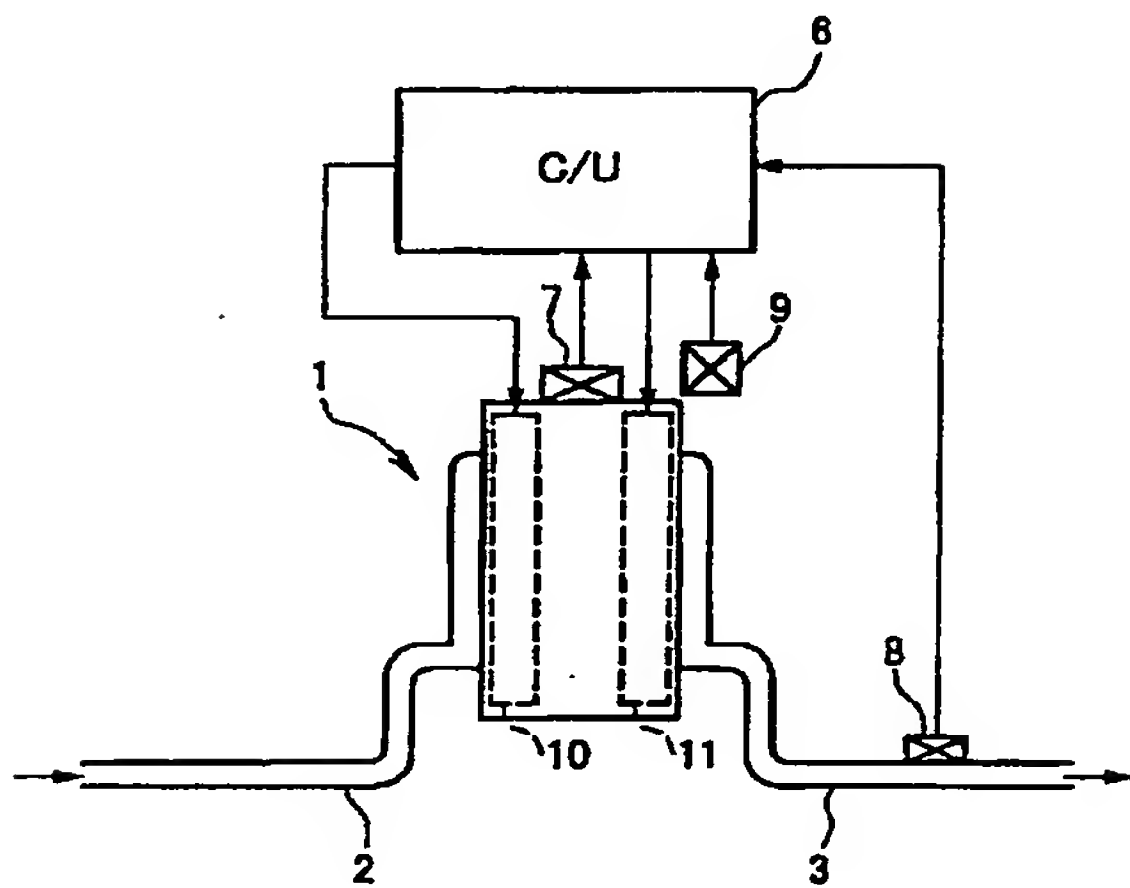
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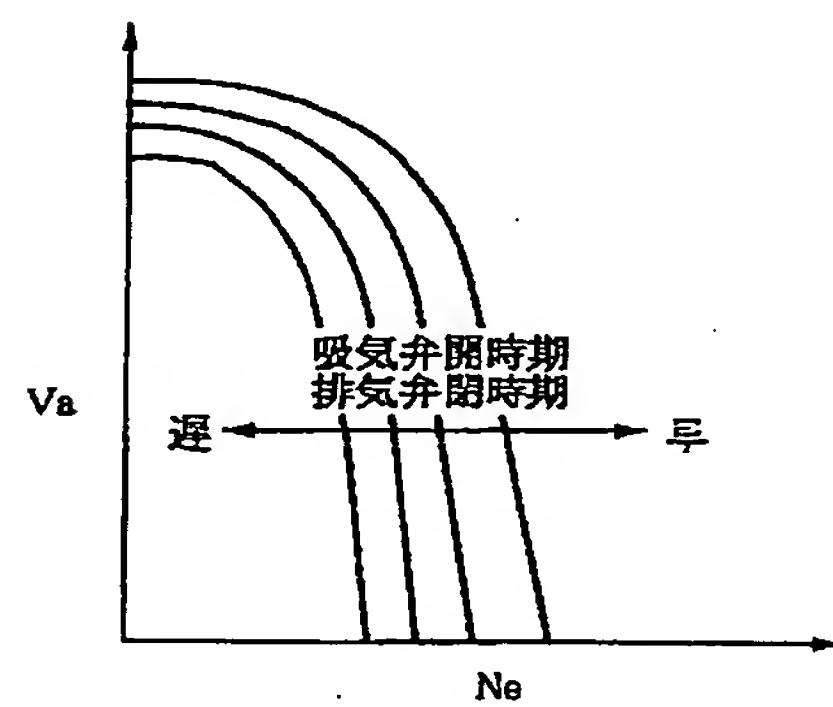
【図17】



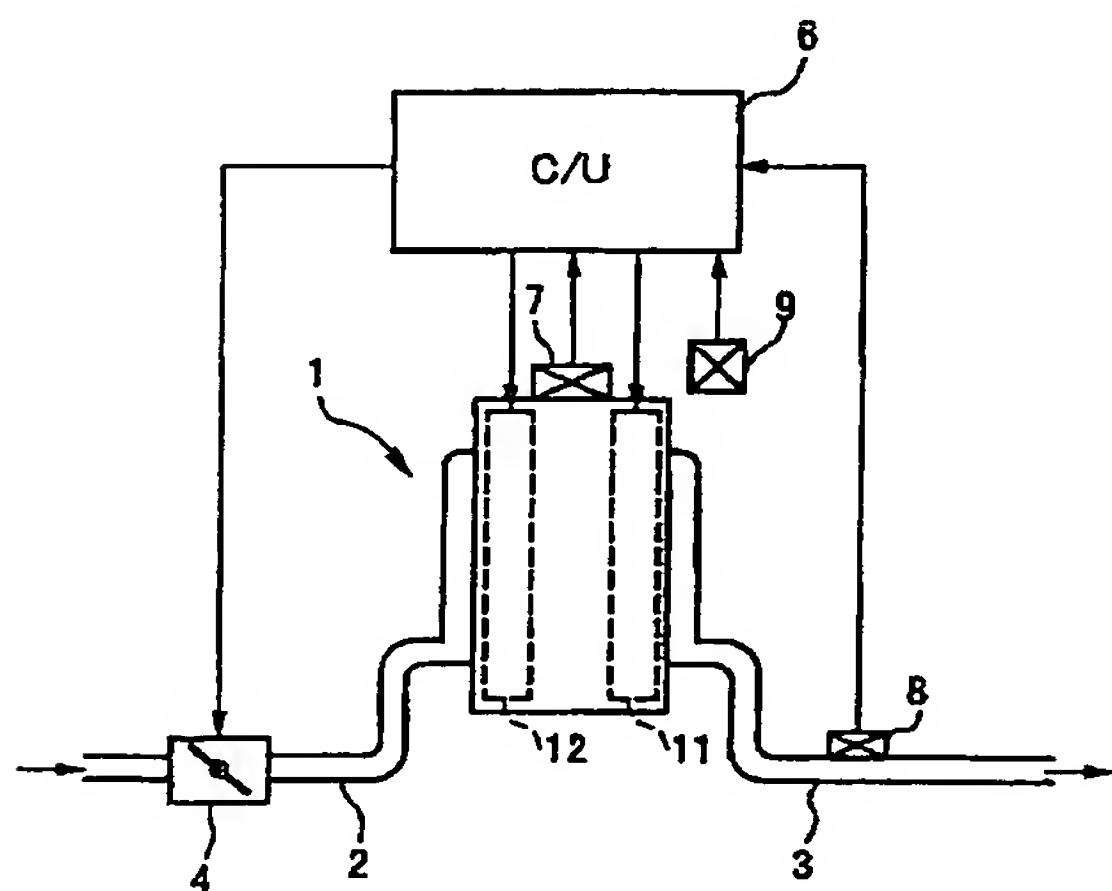
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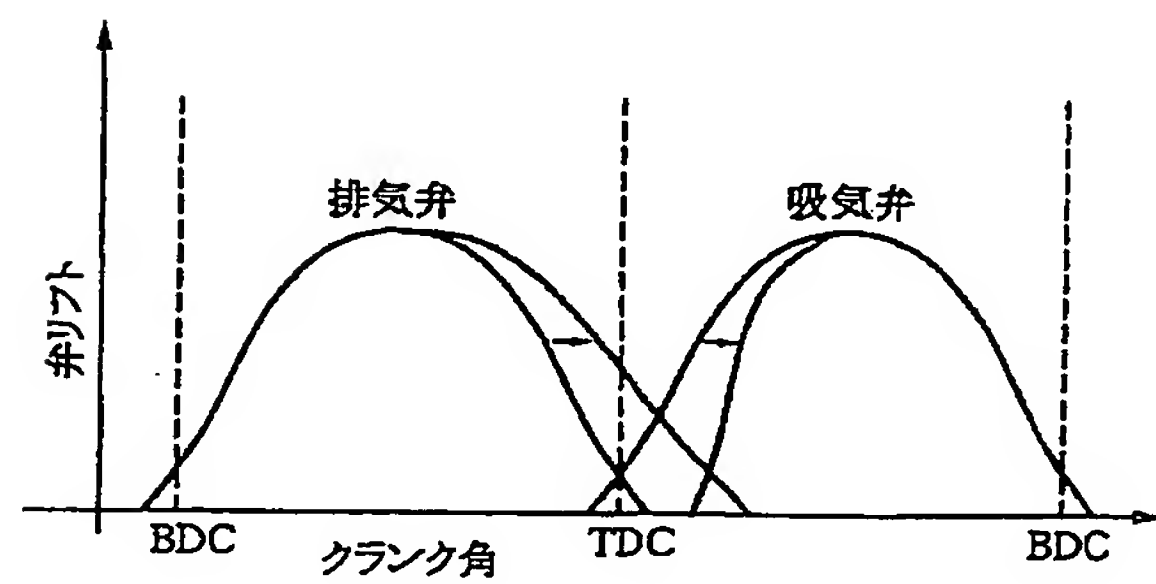
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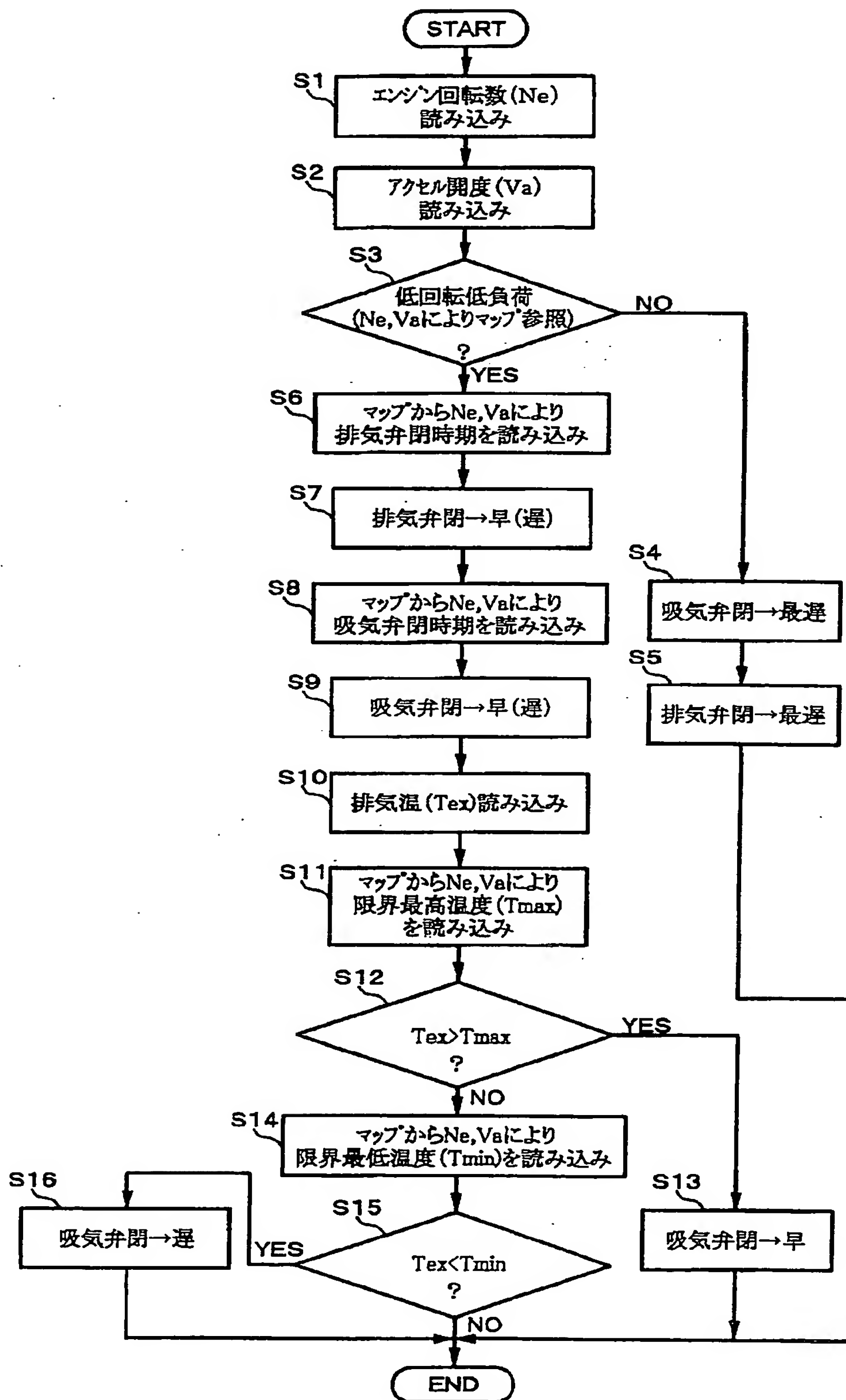
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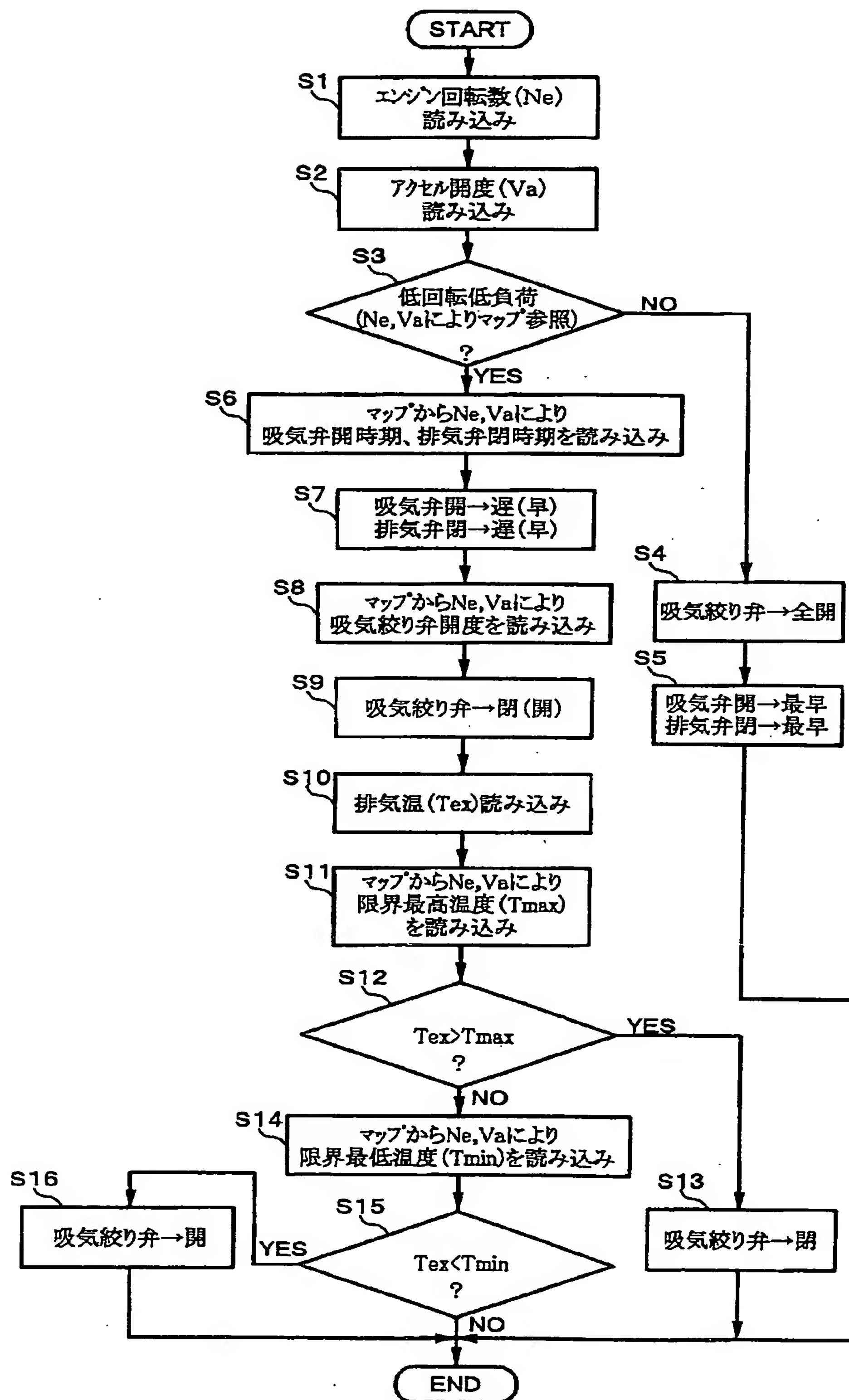
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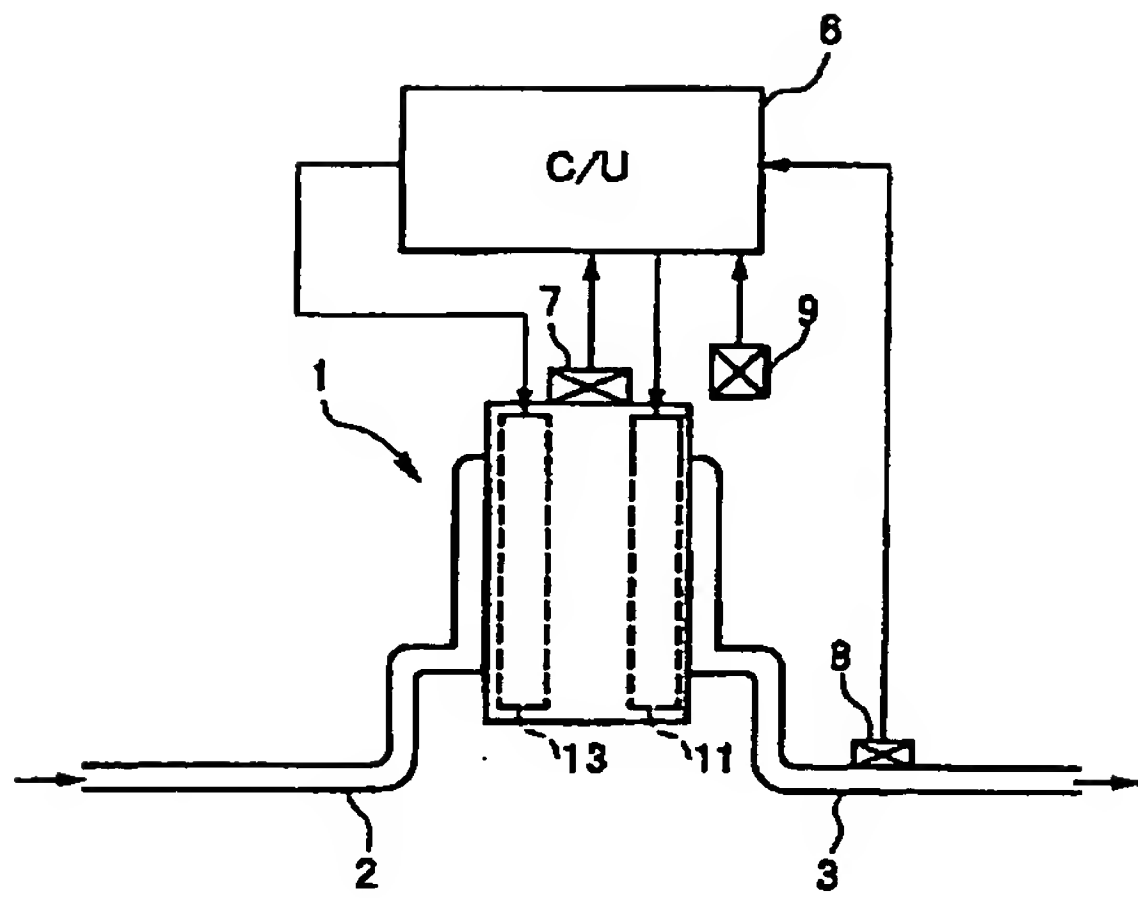
【図16】



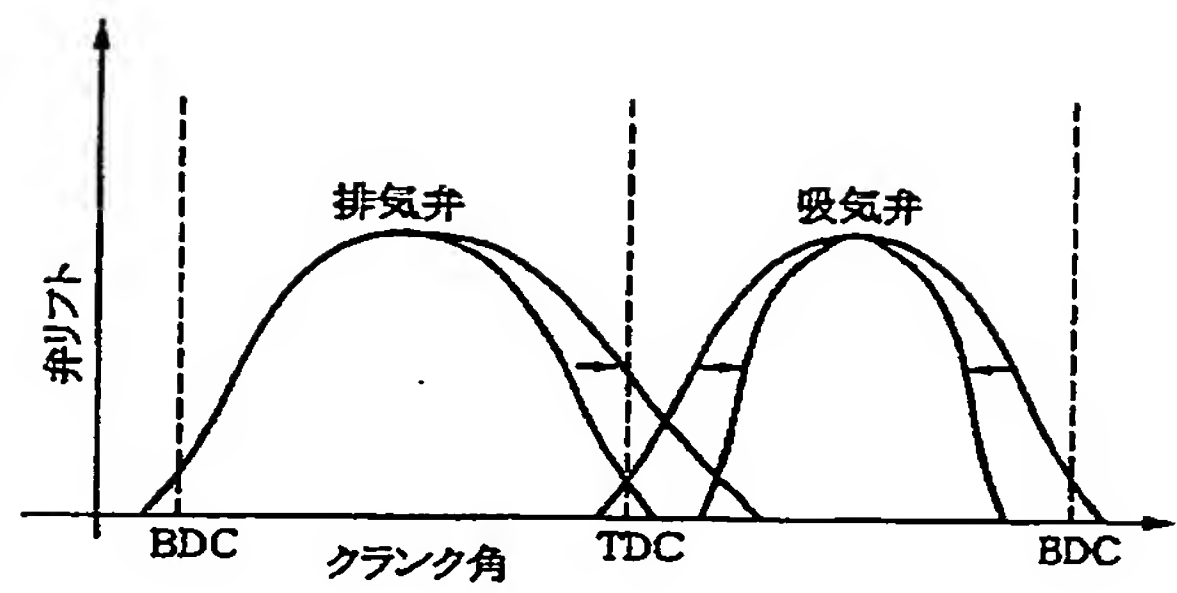
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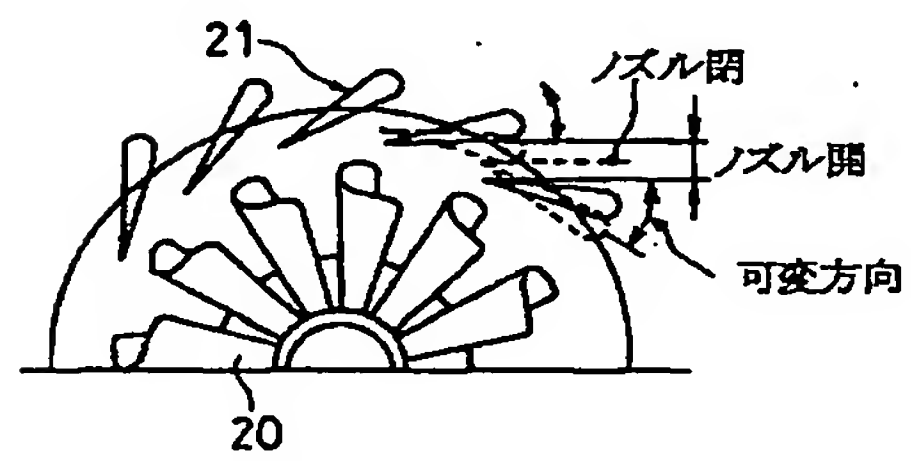
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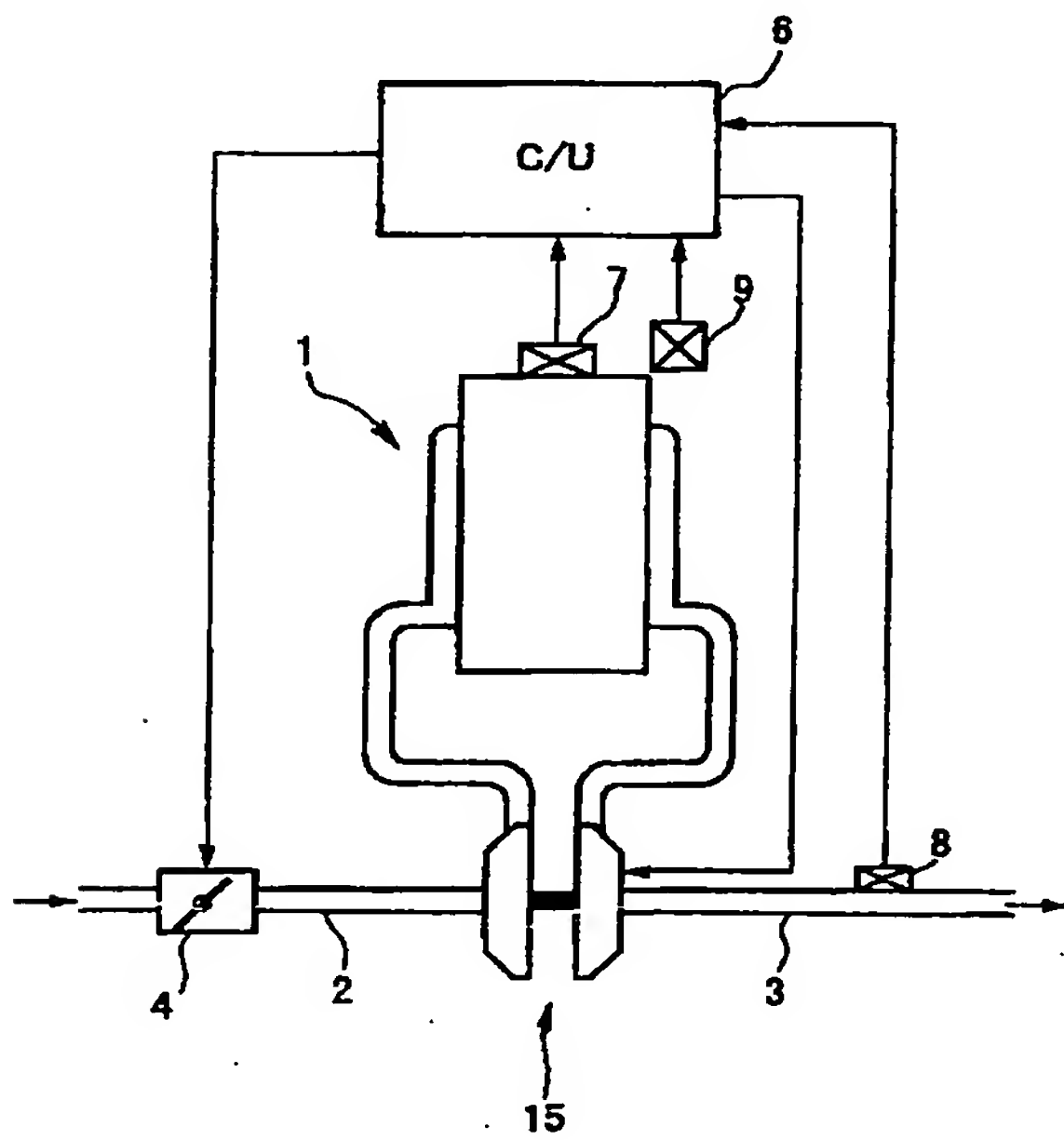
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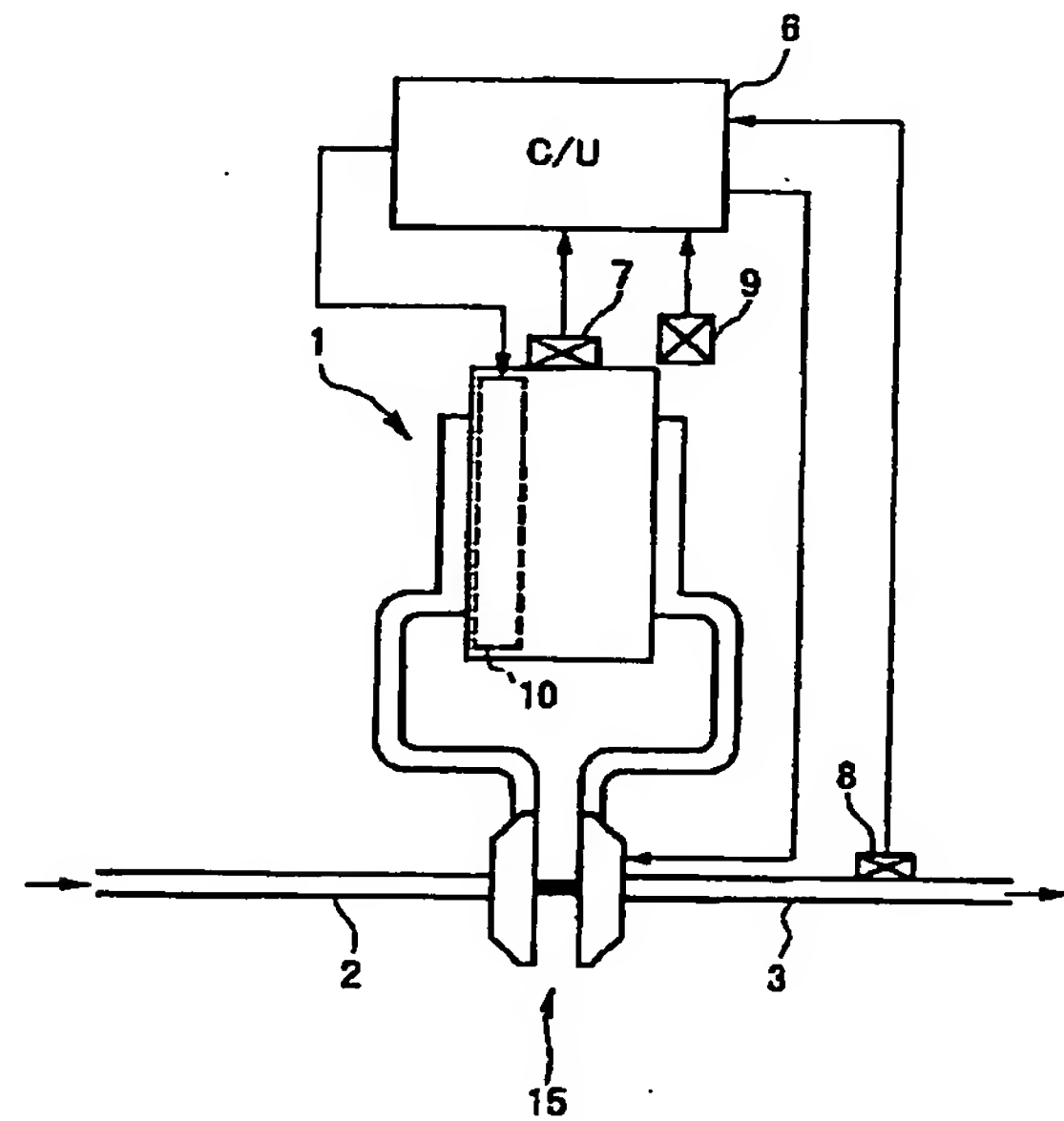
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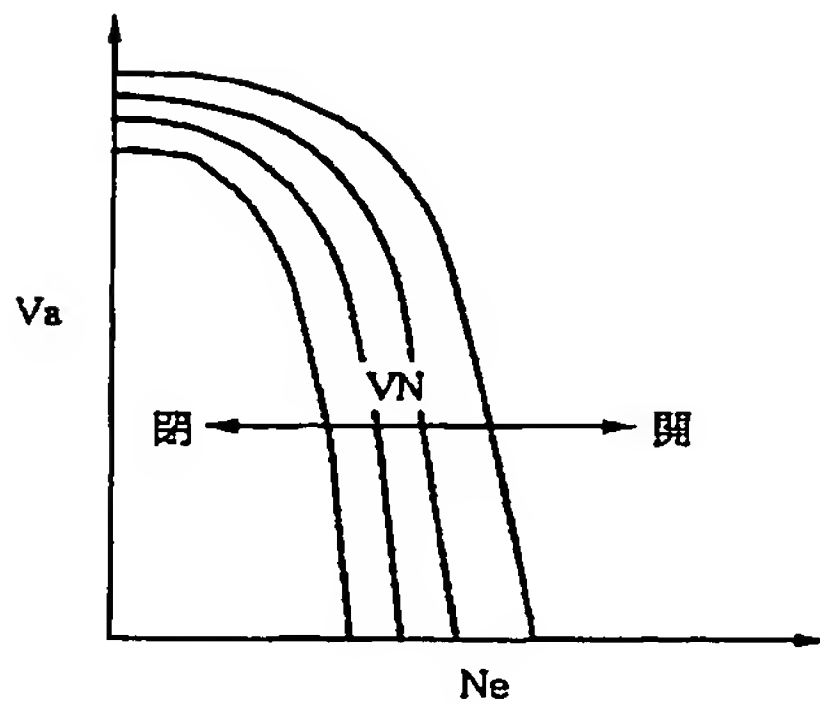
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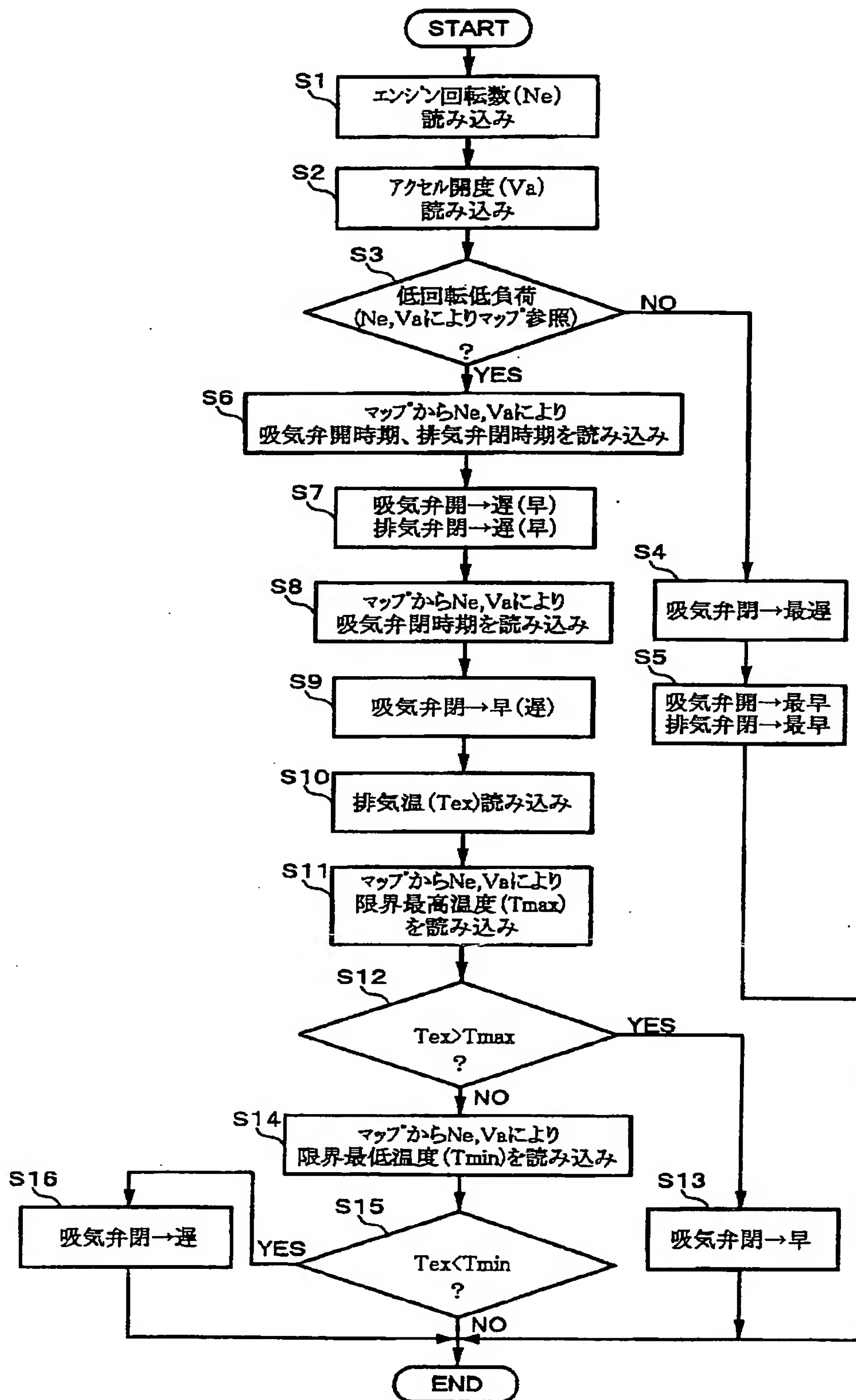
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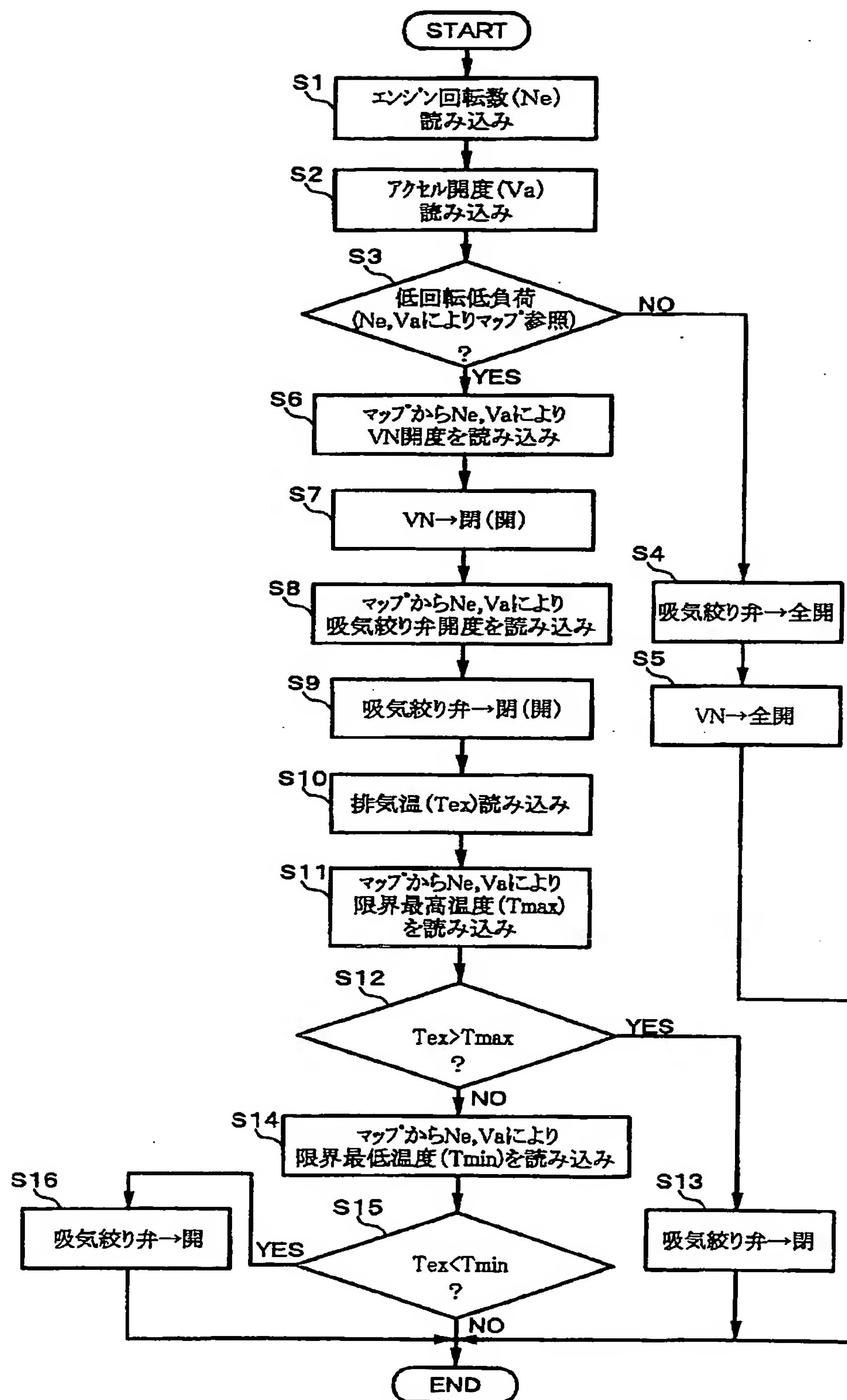
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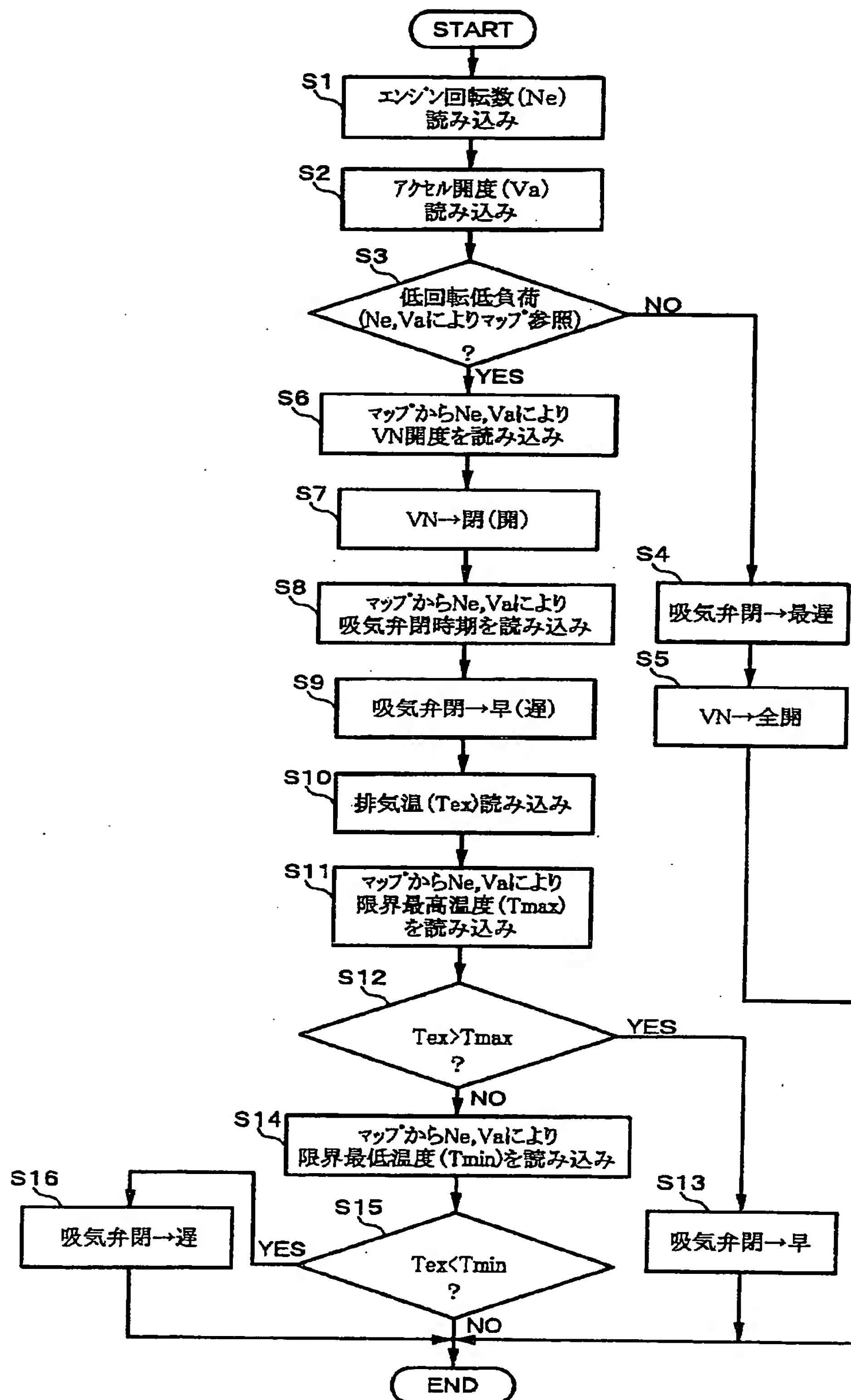
【図24】



【図27】



【図30】



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37/12	3 0 2	F O 2 D 9/04	3 0 2 Z
F O 2 D 9/04			D
			C
41/04	3 6 0	41/04	3 6 0 E
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	3 7 0		3 7 0
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			5 7 0 J
			5 7 0 P
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 EA31 EA32 EA35 FA01 FA07
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